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West Europe Report

SCIENCE AND TECHNOLOGY

FRG INFORMATION TECHNOLOGY: PERSPECTIVES, GOALS, FUNDED PROGRAMS

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Preface

The production, processing and dissemination of information in modern industrial societies is increasingly assuming the character of an independent factor of production along with labor and capital. Especially in view of the strong export orientation of the Federal Republic of Germany, the ability to develop and market modern information and communication technologies and microelectronics as the technology on which they are based is a very essential factor in the competitive ability of our country.

For this reason, the Federal Republic must strive for a leadership position in the field of information technology.

This is possible if

- *people in the Federal Republic accept the challenge of this technology both with regard to education and continuing education as well as in the media and in public affairs;*

- *the private sector actively seeks out markets and meets the challenge of international competition;*

- *the state eliminates obstacles and offers its assistance by creating favorable conditions in those areas where its help is most effective .*

Federal Chancellor Dr. Helmut Kohl announced in his policy statement of May 4, 1983, a comprehensive plan according to which the Federal Government will support the development of microelectronics and of information and communication technologies. This plan is not merely limited to the subsidizing of technological developments, but was worked out under the leadership of the BMFT in cooperation with other federal agencies and includes their contributions.

The entire plan was approved on March 14, 1984 by the Federal Cabinet. By the measures contained in this plan, the Federal Government documents its determination to take up the challenge of information technology and to improve the competitive position of the Federal Republic of Germany in this area.

The government is counting on the dynamism and the innovative ability of German industry and it puts its faith in the readiness of the people in our social market economy to learn and to perform; it is confident that all those involved will act in a spirit of partnership.

The Federal Minister for Research and Technology

[signed,]
Dr. Heinz Riesenhuber

I. Summary

The ability to develop in time modern information and communication technologies and microelectronics, the technology on which they are based, and the ability to implement these technologies in accordance with the market situation is a very critical factor in determining the competitiveness of highly developed industrial societies.

An important prerequisite for this is a productive information industry. However, international competition in this market is not intensifying for this reason alone, but also because of the recognition that all over the world information technology is a growth area which more than many others promises high growth rates in the long-range view.

The prosperity of our society depends to a great extent on a competitive economy. For this reason, the challenge of information technology must be accepted. The perspectives of information technology must be soberly considered, taking economic security as a parameter, without overlooking related social problems.

In several areas the German information industry enjoys a leading position in the world. However, the Federal Government notes with concern that the competitiveness of German information technology in microelectronics and in some areas of data processing is endangered because of worldwide efforts in this area, although it has been able to maintain a strong position in technological terms.

The various branches of information technology overlap and exist in a close reciprocal relationship with each other. Thus, there can be in the long run no successful communications industry without an efficient data processing industry. In the long run, neither the data processing industry nor the communications industry can be conceived of as being successful without microelectronics.

In information technology, sharp international competition exists which forces businesses in the Federal Republic to produce outstanding results. On the one hand, the German market for local suppliers is relatively small; on the other hand, the information industry in the main competitor countries receives direct and hidden state support as well. These come, e.g. in the USA, from publicly supported defense research and development, and in Japan from the close cooperation that exists between the state, industry and publicly financed research.

The Federal Government is hereby presenting a comprehensive plan for the support and subsidizing of the development of microelectronics and information and communication technologies, as it announced in its Policy Statement of 1983. With this plan, the government is documenting its determination to accept the challenge of information technology and to improve the competitive position of the Federal Republic in the area of information technology. In this plan, the government is counting on the dynamism and innovative ability that are inherent in the German economy. The objective of these measures, which are an integral part of the overall economic concept of the Federal Republic, is above all to support the German information industry in its endeavors to take advantage of the opportunities represented by the future markets in a market-oriented fashion by means of providing an improved conditional framework. In offering this support, one goal is to utilize broadly-applied indirect measures more strongly than was the case in the past. These measures are also aimed at concentrating the limited economic and development resources in our country and at bringing about a more effective application of the results of research and development.

After careful study, the Federal Government has decided upon a plan that provides for measures in five different areas:

1. Improvement of the market conditions and thus also of the competitive position of the Federal Republic and Europe with special stress on venture capital, the opening up of markets and innovation-oriented public procurement policies;

2. Motivating people to take up the technological challenge by providing them with information concerning future options and by paying increased attention to information and communication technologies in the area of education;

3. Stimulating innovation-oriented markets by a future-oriented expansion of the communications infrastructure and innovations in the area of final products.

4. Extending the technological base for a long-term securing of the defense capability of the FRG;

5. Strengthening and concentrating the research capacity of the FRG in the area of information technology with the goal of developing an R&D capacity in the public and private sectors, which in certain focal areas will meet the requirements of future international competition in terms both of quality and of quantity.

The Federal Government regards the challenges that must be met as a joint task confronting the private sector, science and the state. Confidence in the ability of science and industry to adapt and perform and in societal cooperation are important factors.

The government is relying on the willingness of the people in a social market economy to be productive, on cooperative behavior by all participants and on the excellent initial position of the German economy in export markets.

The Federal Government is also aware that the challenge of information technology cannot be met solely within a national framework. Within the European Community, the FRG is engaged in efforts aimed at the realization of a homogeneous European domestic market, at a free exchange of commodities with third countries and at conditions which improve the competitive ability of the EC, especially in the area of information technology. For this reason, the FRG is seeking increased cooperation with its European partners. For this reason, cooperation by businesses in projects which are of mutual interest would be an appropriate starting point.

II The Significance of Information Technology for the Economic and Social Development of the Federal Republic

Information technology — from the basis technology of electronics to the systems concepts of data processing and of technological communications on up to the applications areas of industrial automation, office technology and entertainment electronics — is of fundamental importance for the economic and social development of the Federal Republic.

For large portions of our society, information technology means hope for continued economic growth, for new jobs, more freedom and conveniences in day to day life; for some, however, it is a source of concern.

In view of the sluggishness of the global economy with its continuing impact on the employment picture, the situation in the Federal Republic must be assessed in a way that is as free as possible of wishful thinking and irrational anxieties. The perspectives of information technology must be soberly considered under the viewpoint of securing our economic future without ignoring or overlooking social problems.

II.1 The Central Role of Information Technology

The prosperity of our society depends to a great extent on a healthy economy and on the ability of people to pursue employment in keeping with their education and qualifications. In this process, technology has always played a central role. In the coming decades, information technology, unlike almost any other technological development, will affect the lives of people and economic competition between the various national economies. This change will be accelerated by rapid developments worldwide in information technology.

The economic and employment pictures will be radically changed in their structures, requirements and characteristics. Information technology can lead to the creation of new jobs, but also to the elimination of existing ones, and can give new meaning to individual occupations.

The forms of human interaction, especially within the family, will also be affected. The opportunities for individual activity will be expanded, but the new technical possibilities can also lead to a reduction in personal contacts. With regard to the effects that new media have on family life, the scientific advisory commission for the family at the Federal Ministry for Youth, Family Affairs and Health has worked out a position and outlined recommendations.

The new information technologies will affect the structures of political opinion-shaping and the democratic decision-making process. And finally, they will also change the culture of our society, since the forms of communication are a critical factor in shaping the culture of a society.

Information technology is of increasing importance for the defensive capability of the FRG. New defensive weapons technologies with electronic guidance systems and new technologies for reconnaissance and communication make an improved defense capability using conventional weapons systems seem likely.

Similar to the way in which the entry into the machine age enhanced human strength by the use of machines, information technology functions as a performance amplifier: it strengthens human intelligence by supporting and expanding the human capacity to store, process and relay information:

— Even today, it allows available information to be rapidly accessed and thus makes is possible to discern relationships which formerly went unrecognized, thus making possible a better basic orientation.

— It helps to overcome obstacles to communication in terms of distance and time.

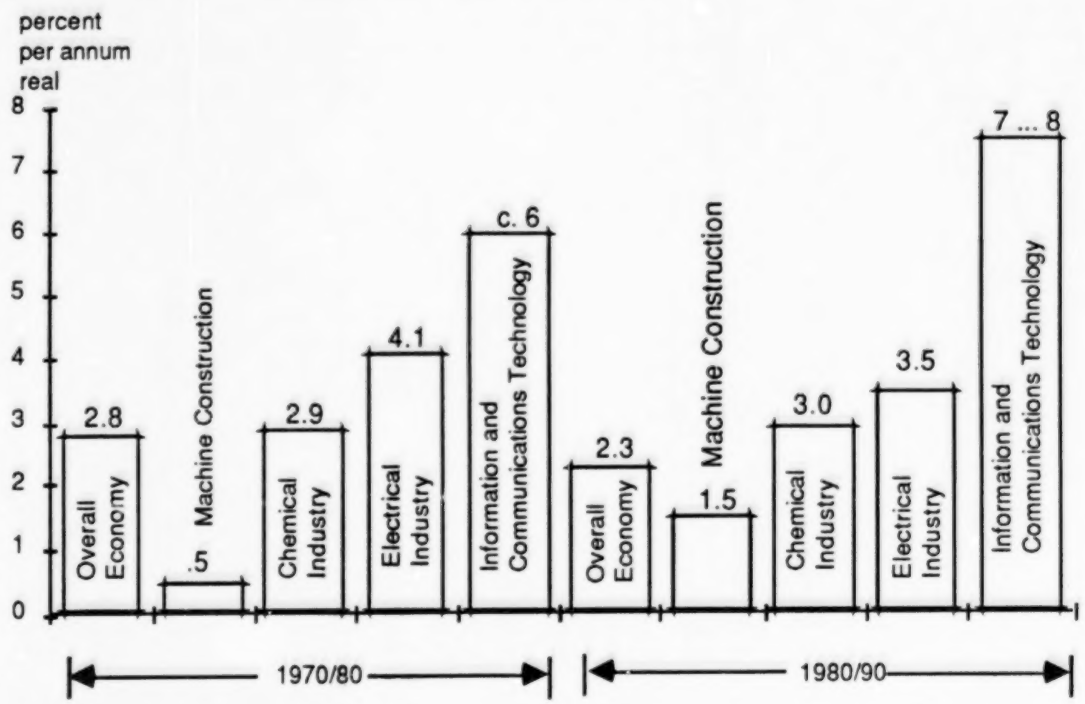
— It allows complicated problems to be solved in reasonable time periods.

— It allows the automation and control of information and control of production and transportation processes.

— It makes it possible to deal with routine administrative tasks in the public and private sectors, the scope of which could not be managed without its help.

— It also carries risks in terms of the protection of the private sphere because of the new technological possibilities inherent in the compilation of data, and thus raises a need for certain requirements in terms of data protection.

Illustration 1



Real Growth of the Information Technology Industry in Comparison with other Branches of the Economy in the FRG

Source: AEG-Telefunken

In the development and introduction of information technology, the Federal Government focuses especially on the opportunities, and it will take steps to minimize possible negative consequences. The FRG will take up this challenge as a democratic and open society. In order to take full advantage of the opportunities and to minimize the risks, a constant dialogue between the state, society and private citizens is necessary.

In numerous studies, commission reports, strategy talks and memoranda from the private sector and science, the significance of the key technology of information technology has been studied and discussed. A list of the most important materials used in compiling this report is included in the Bibliography. Many types of suggestions were used in designing the government plan, without reference being made to each of these by cross-referencing and quotations.

II.2 The Information Industry as a Growth Industry

The information industry is a growth industry. A look at the real growth of the most important economic sectors in the FRG over the past decade (Ill. 1) points up the special position held by information technology.

For this decade, Figure 1 indicates a growth prognosis of an annual average of 7-8 percent for information technology in the FRG, a figure which clearly surpasses the growth expectations for most of the other industrial sectors.

Industrialists in the USA expect the information industry there to move from seventh position to fourth position in the ranking of industrial sectors, and believe that by the end of this century it will have attained second place. The growth expectations linked to this development are of great importance in the international competition for markets and jobs.

II.3 Influence of Information Technology on the Economy

Many feel that from an economic point of view the production, processing and distribution of information is assuming in modern industrial societies more and more the character of an independent production factor, along with labor and capital.

This is accompanied by a structural change that not only in the FRG, but worldwide, has serious consequences for the national economies of the industrialized countries:

— More and more people are no longer employed in the production of material goods or services, but rather are concerned basically with the production, processing and/or distribution of information.

— At the same time, however, a rapid development in information technology is taking place, which is making it possible to increase productivity both in industrial manufacturing and in administrative and service areas.

— More and more people are no longer employed in the production of material goods or services, but rather are concerned basically with the production, processing and/or distribution of information.

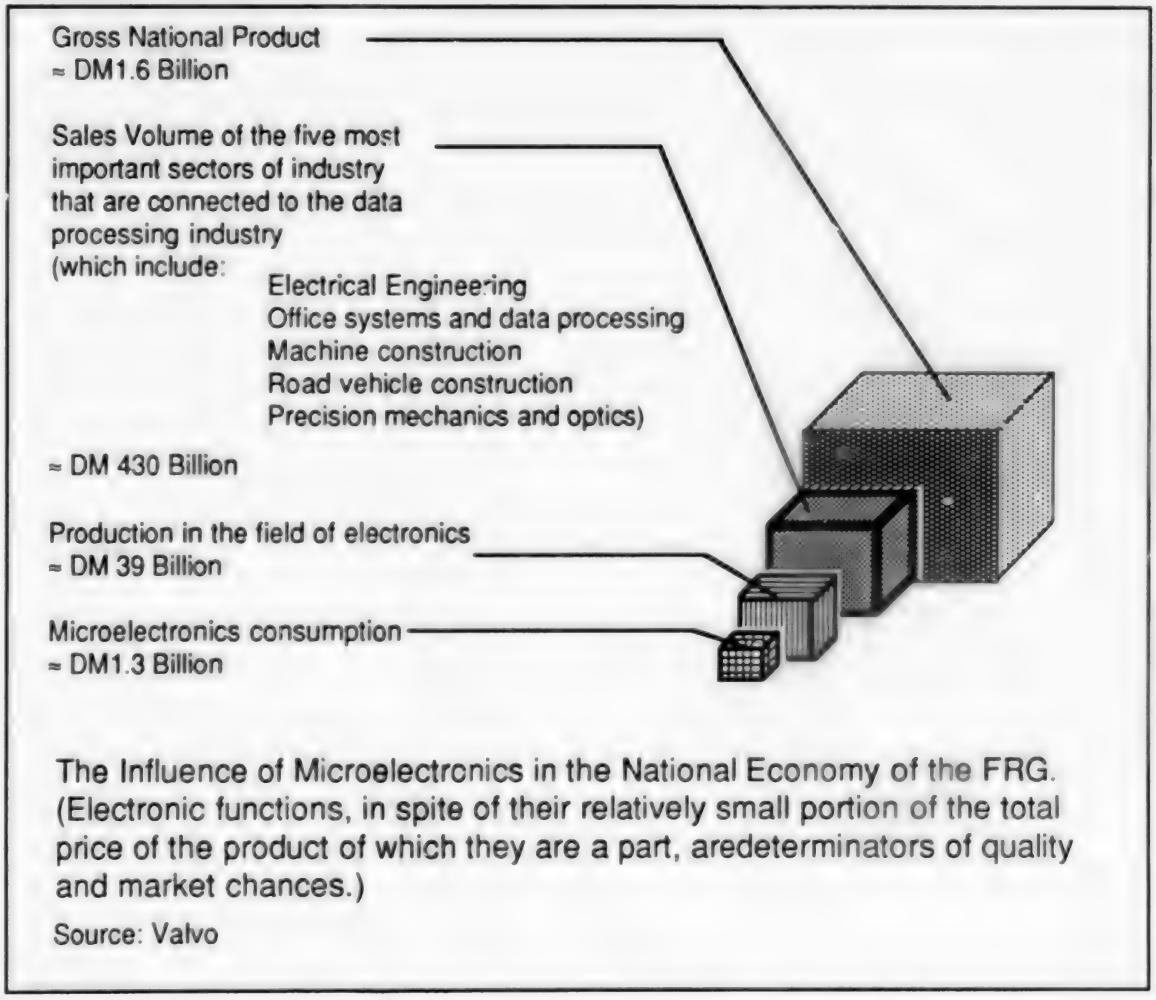
Experts do not believe that information goods and services will become an important stimulant for consumer end-demand in the national economy. Information technology will, however, be economically dominant in the developmental tempo of the investment goods area. Hardly a

business exists today which can afford to neglect state-of-the-art information technology in its production processes.

Many experts believe that information technology will be of decisive importance for industrial productivity.

More and more industrial sectors, such as machine construction, the optical and chemical industries, the auto industry and particularly the electrical industry are also dependent on the use of information technology in the design and manufacture of their products. The way in which these products are shaped by information technology is manifested not so much in the large share of information technology in terms of value (Ill. 2), but rather much more in indispensable functions (electronic control, measuring, regulating, displaying, detecting, sensing). It is these electronic functions which, despite their relatively small share in the total value of products, determine the quality and market chances of these products.

Illustration 2



The Influence of Microelectronics in the National Economy of the FRG. (Electronic functions, in spite of their relatively small portion of the total price of the product of which they are a part, aredeterminators of quality and market chances.)

Source: Valvo

The influence of microelectronics will continue to increase. If one compares the expected degree of utilization of microelectronics in the year 2000 (corresponding to 100 percent) with the present situation, according to the estimates of specialists, only 15 percent of the potential of microelectronics are used today. This development is being moved decisively ahead by the very rapid increase in the complexity and efficiency of electronic circuits (Fig. 3). This

abstract principles and with information systems will be required of a growing number of workers.

It is therefore important to take advantage of the opportunities inherent in the development and application of information technology as quickly as possible and in a way that is appropriate to market conditions. The investment goods sector is especially important. But secure jobs also result from investments in communications systems, new control techniques for an environmentally-sound and energy-saving operation of heating plants, new regulating techniques for motor vehicle engines and a large number of household and consumer items.

II.5 Influence of Information Technology on Public Services

The use of automated data processing has become a matter of course in public administration and has been considerably improved in terms of efficiency and economy.

In the past, however, the expansion of tasks in relation to the technology that was available at the time brought about in many cases a sense of alienation on the part of the citizenry. Today the use of modern technologies--particularly the development of decentralized solutions with comprehensive services--opens up the possibility of new structural modes for public administration, which promise to be more accessible to private citizens and to enhance the quality of services, while at the same time improving the cost-effectiveness factor.

The problem of the abuse of personal data has become more serious because of the expanded possibilities of the storage, compilation and evaluation of information with the help of modern information technology. In order to avert these dangers, the legislature passed the Federal Data Protection Act (BDSG), which governs the processing of personal data in both the public and private sectors. The general view holds that the design of this law has proven its usefulness. To the extent to which changes in the law are necessary in keeping with technological progress in the area of information processing, however, they should come about by way of an amendment. In this regard, attention should be paid to the data-protection determinations found in the judgement of the Federal Constitutional Court of December 15, 1983, with regard to the Census Law of 1983.

A further task concerns the care which must be exercised to avoid becoming so dependent on technological systems that in the case of a technological break-down in certain areas, serious disadvantages would result for individual citizens or for the state and the economy. The vulnerability of a society that largely depends on information technology is, in the view of specialists, a problem which must receive increased attention in the future.

The quality of public services, which is both an indication of the achievement level and a competition factor for a highly developed industrial society such as ours, is to a very great extent determined by a modern information technology infrastructure. For this reason, new possibilities in the area of information technology must be exhausted in a deliberate way.

In the future, the coming together of data processing and of technological communications, by means of videotext in the home and by data processing networks in public administration, in monetary transactions, in commerce and in insurance, a new form of service will come about which will allow the individual citizen to take advantage of public and private services from the home. This will require learning processes both for those who offer the services as well as for those who utilize them.

II.6 Influence of Information Technology on the Media

With the introduction of television, communications technology found an extraordinarily wide application. The new technologies will considerably expand the possibilities in this area. For the print media, too, information technology has led to changes with regard to topicality and production technology and in the future as well, will continue to have other effects. The previously existing boundaries between individual and mass communication will be more difficult to distinguish as a result of technological developments.

The development of information technologies opens up here, too,--as in the area of public services--new possibilities for action in the transition from a more passive media consumer to an active participant in society's communication processes.

Key words in this process are the utilization of picture-taking using one's own electronic camera, calling up programs from a video library, the use of television in connection with videotext, video games or group-oriented instructional and television programming. Traditional structures will be profoundly altered in this process. The Federal Government considers it necessary to develop policies for this development in order to take advantage of the opportunities and to minimize the risks involved. In this regard, it will develop its proposals for futyre media regulations.

II.7 Transformational Processes in Information Technology

Assessing the significance of information technology for the future of the economy and society of the FRG is complicated not only by the fact that the causal relations are extremely complex. An additional factor is the extraordinary dynamism inherent in this technology.

Within the field of information technology, data processing techniques and communication techniques developed differently and largely independently of each other in the 1970's. In this development, each of the areas, assisted to varying degrees by tremendous advances in semiconductor technology as a base technology, had a different development tempo. In the future, both areas will grow closer and closer together, with regard to the base technologies, systems concepts and also with regard to markets. Radical technological changes as a result of far-reaching digitization of information networks and final products must be dealt with. Optical communications is emerging as a new transmission medium. The coming together of digitization and optical communications poses an extraordinary challenge to business. The previously separate processing and transmission of data, text, speech and images is being combined in the form of new integrated systems solutions. The development trend is heading in the direction of multi-functional end devices which are linked with each other by service-integrated communications networks.

The boundaries are disappearing between data processing, communications technology, industrial automation, office technology and entertainment electronics. An example of this is shown in the configuration of an "intelligent" home terminal in which entertainment electronics is combined with data processing and communication technologies.

Microelectronics is the driving force underlying these changes. This technology is responsible for the fact that computers are becoming smaller, cheaper and more efficient. The high growth rates for computers with microprocessors (desktop computers) as compared with the decline in the market share of central processing units for general-purpose computers is an indication of this development.

The growing complexity of the systems goes hand in hand with the increasing demands that users place on the "user interface" of computers. High-resolution CRT's, speech recognition and voice output, image input, manipulation and output and above all an improved management of complex systems by means of user-friendly software are characteristic development trends. The gradual transition from data processing to "knowledge processing" is regarded as the most important long-term perspective.

The rapid innovation tempo additionally determines a shortened product cycle in the marketplace. The products of information technology must be constantly updated in keeping with technological progress.

This leads to an intensification in competition and forces industry to carry out enormous preparatory work in R&D, which often is on such a scale that individual enterprises cannot deal with it on their own.

Competition in the marketplace and cooperation between competitors in development work is therefore a combination that is frequently encountered in this industry.

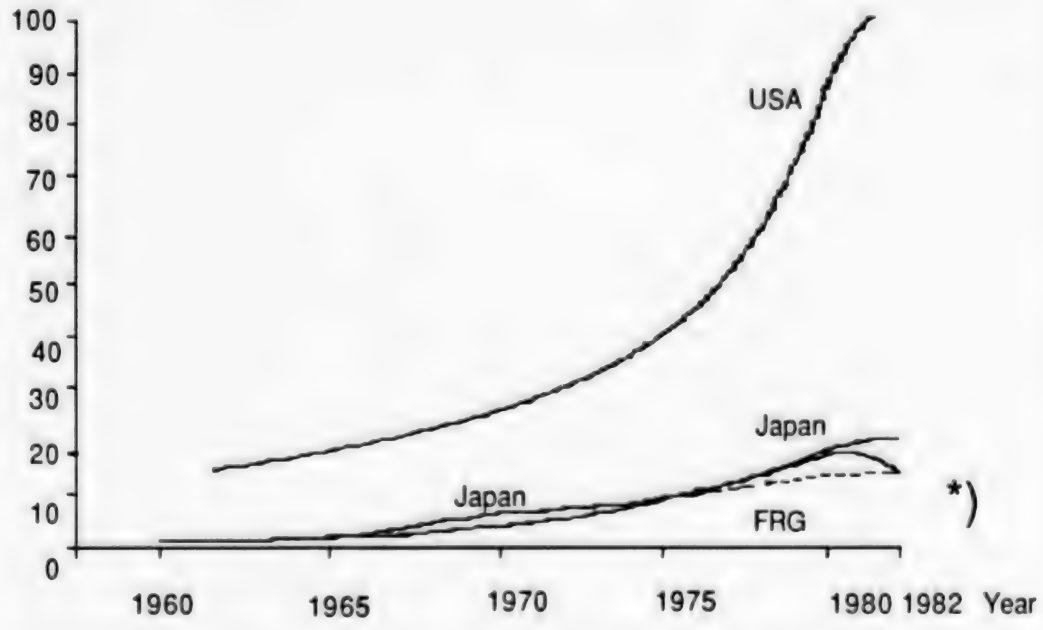
The imaginative and technically-founded speculation concerning transformational processes in information technology, high levels of investment in research and development and highly-developed technical marketing strategies have become basic prerequisites for businesses which wish to successfully utilize the transformational changes inherent in information technology.

III An International Comparison of the Situation in Information Technology

Information technology consists of five areas which, to be sure, cannot be sharply differentiated from each other:

— electronic components and microelectronic systems;
— technological communications;
— entertainment electronics;
— data processing and office technology;
— industrial automation.

Illustration 4

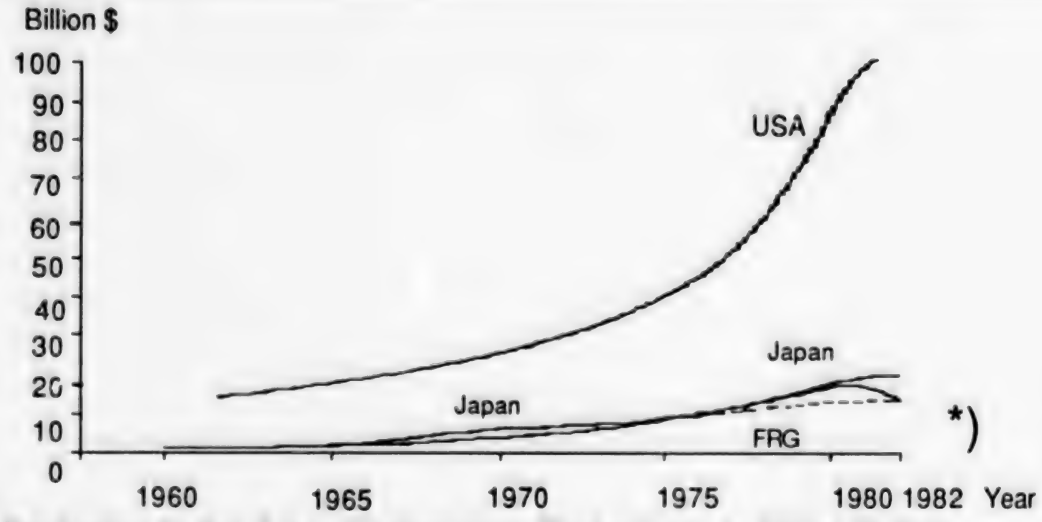


The Market for Information Technology from 1960 to 1980 in Billion Dollars
*) based on a fixed exchange rate of $1 = DM 2.40

Source: Gnostic Forschung GmbH

The development experienced by US, Japanese and German goods in the area of information technology in world markets since 1960 is shown in Illustration 4. Japan clearly surpasses the FRG in volume of production (Ill. 5), a certain indication of the growing export strength of Japanese industry. The relatively weak German position contrasts with the export strength of German industry in other industrial sectors, in which the combination of information technology and mechanics for new systems solutions is in the foreground. In addition to the expected strong increase in market volume in all three countries, it is noteworthy that the Japanese market, similar to the situation existing in Germany, developed from a relatively low level.

Illustration 5

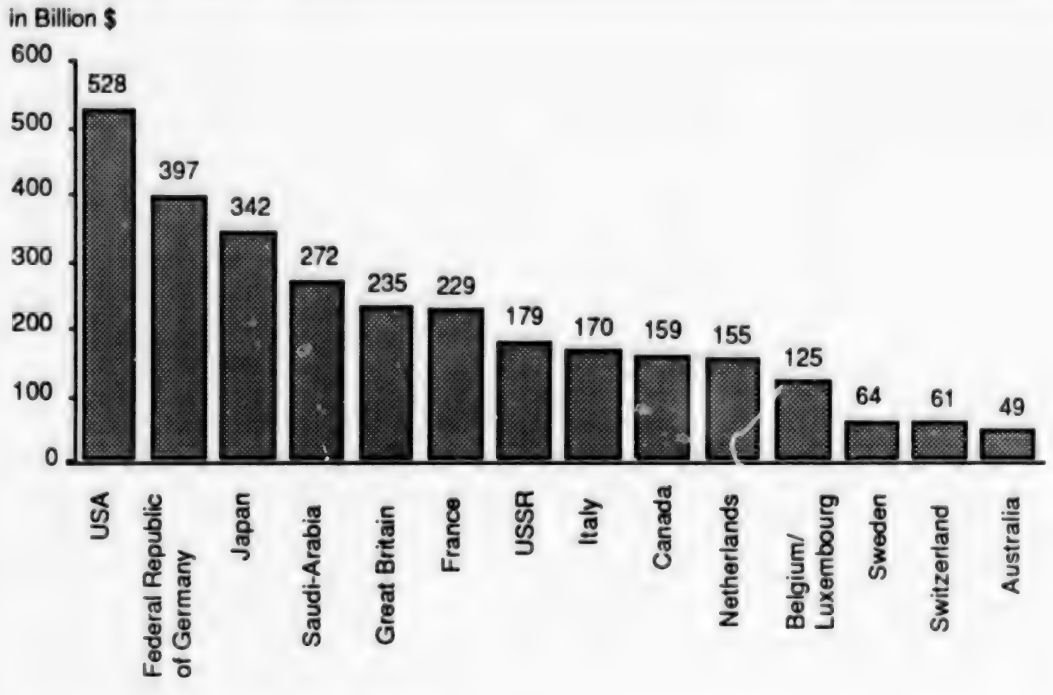


Production in the Area of Information Technology in Billion Dollars

*) based on a fixed exchange rate of $1 = DM 2.40

Source: Gnostic Forschung GmbH

Illustration 6



German Trumps on the World Market:
Exports of the Federal Republic of Germany in Billion DM

Source: Statistisches Jahrbuch 1982 [Statistic Yearbook 1982]

The Federal Republic is one of the strongest exporting countries in the world, and despite a slight decline in its world export share during the 1970's, it is still clearly ahead of Japan, which is larger in terms of population. Our country still earns more than one-fourth of its GNP by means of export trade. The FRG is therefore not only an exporting country, but a country that is dependent on exporting. For this reason, its export structure with regard to the technological level is interesting.

Illustration 6 shows that machines, motor vehicles, chemical and electrical products account for more than half of the export trade volume. According to OECD statistics, in 1980 products with electronic primary functions accounted for a relatively small percentage, with 12 percent of delivered goods. According to these figures, a comparison with Japan shows that there the corresponding percentage of sales of such information goods is clearly higher, at 22 percent.

To be sure, attention must be paid to the fact that the area of information and communication technologies is increasingly characterized by an international technological and economic competition of strategic dimensions, in which the European industrial nations are struggling for a long-term position of superiority or to keep themselves from falling behind. In this process, government and industry frequently work in close cooperation with each other. State assistance in other countries is not limited to the support of research and development, but to a much larger extent than is the case here in West Germany, consists in the awarding of government contracts (USA) or in government contracts and loss compensation for businesses (France, England) and joint strategic action undertaken by the private sector and the state in the intensive support of innovation, growth and export measures (Japan).

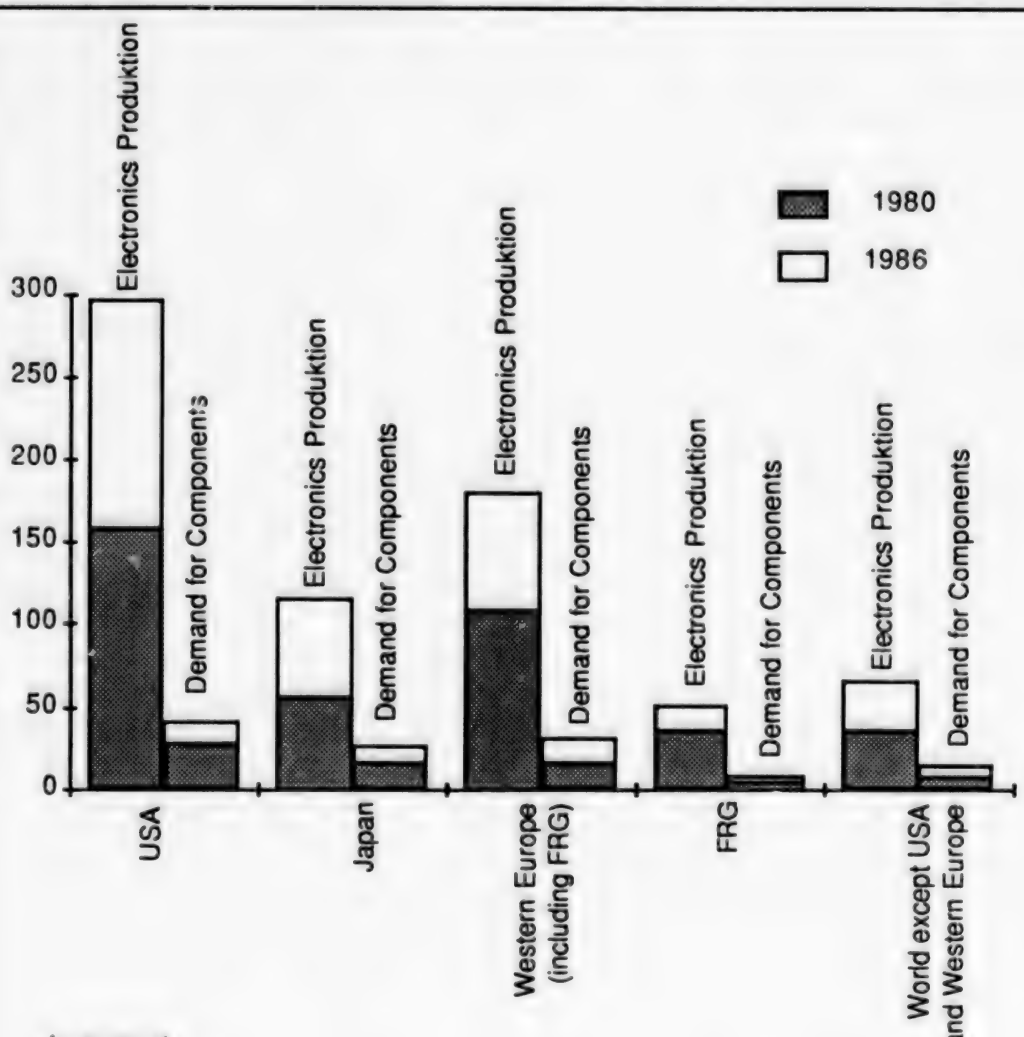
The five areas within information and communication technologies are individually discussed in the following sections. In terms of the limited ability of available data to predict future developments, these statistics should be understood merely as indicators of rankings and trends.

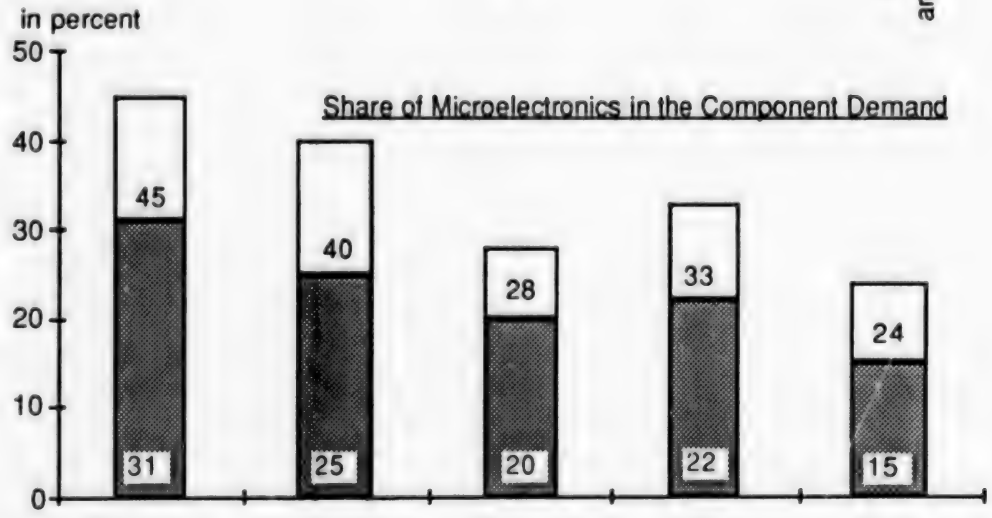
III.1 Electronic Components

The dynamics of the market for electronic components are determined by integrated circuits (Ill. 7). Experts anticipate their share of this market to increase in the FRG between 1980-1986 from barely one-fourth to one-third, in the USA from one-third to almost 50 percent.

The growth rates of the markets for semiconductor components from 1975 on in Japan, the USA and the FRG are shown in Illustration 8. This points up the relatively slow growth of the microelectronic market in the FRG. And in reality, the demand for integrated circuits, relative to the GNP, is at present not half as great as it is in the USA and Japan. This has to do with the dominant position of the USA in the data processing market and the dominant position of Japan in the field of entertainment electronics, and also indicates that the markets for information technologies mutually support each other and that weaknesses in sub-markets affect the entire market of information technology.

Illustration 7

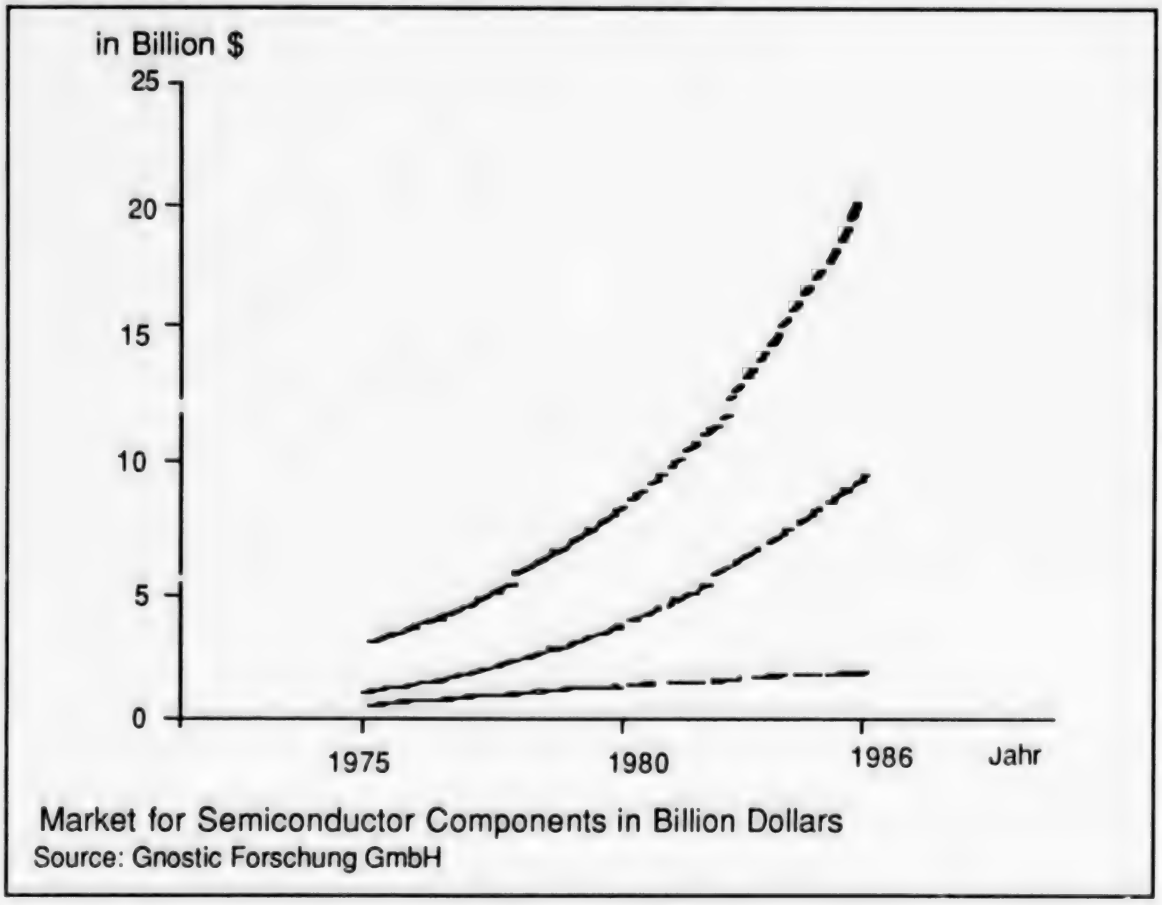




Growth of the World Electronics Production and of the Component Demand in Billion Dollars

Source: Valvo

Illustration 8



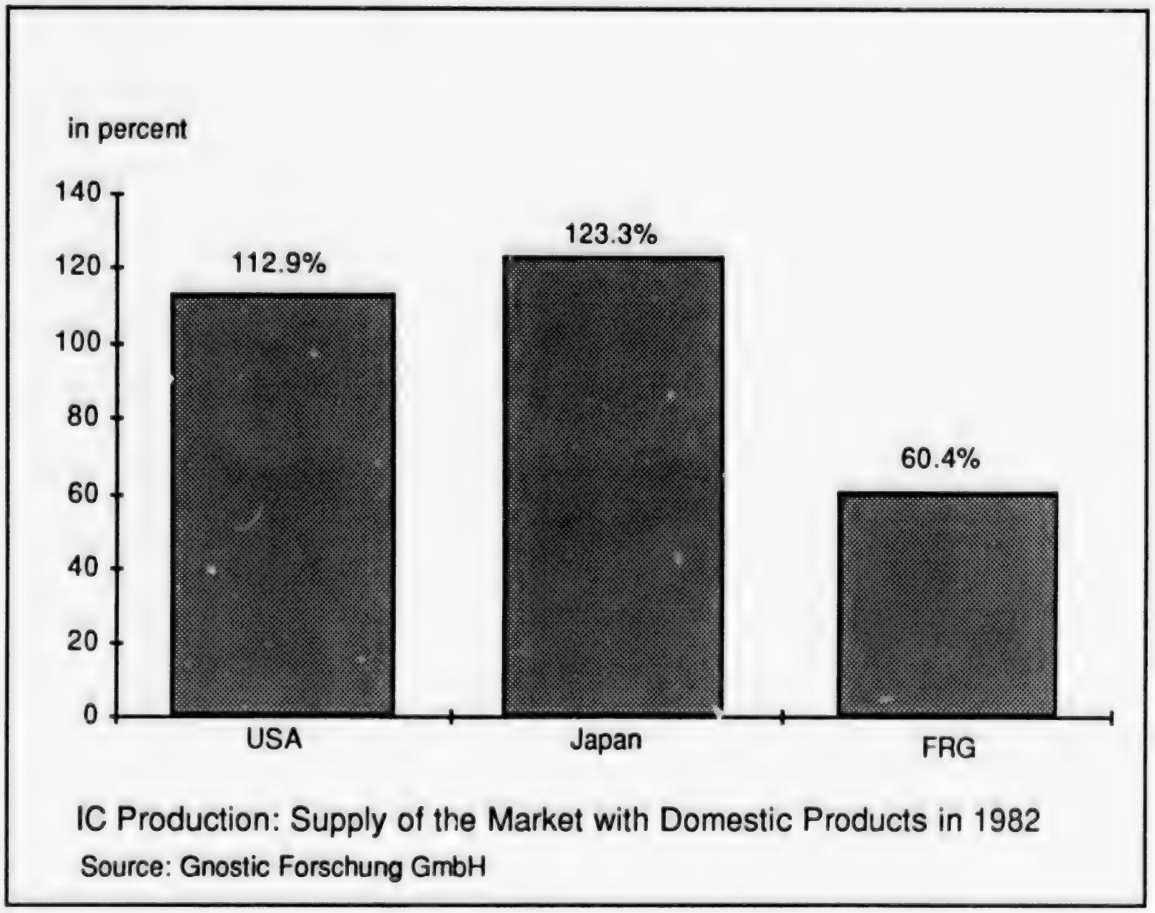
Market for Semiconductor Components in Billion Dollars
Source: Gnostic Forschung GmbH

It is therefore logical that the production of integrated circuits in the FRG is also insufficiently developed as well.

According to studies carried out by the market research institute Gnostic, in the USA and in Japan more is produced than is consumed domestically (the surplus is sent primarily to Europe), while in 1982 in the FRG, 60 percent of market demand was met by domestic production. Figure 9 shows an international comparison made by the same source. According to figures made available by the Japanese finance ministry, in 1982 the export of integrated circuits to the FRG increased by 57 percent as compared with the previous year, while the Japanese imported 25 percent fewer integrated circuits from Germany. This results for many observers in an increasing danger in recent years for innovative systems developments to depend on foreign know-how in integrated circuits used in advanced technologies.

The ranking of the largest manufacturers of microelectronics, shown in Illustration 10, also demonstrates clearly that German manufacturers of integrated circuits do not play an important role at the present time in international terms. R&D expenditures in the FRG for microelectronics, which are financed from profits, are correspondingly small, even though the relative investment of German manufacturers is higher than average. Despite this relatively small R&D budget, the technological position and the development potential of the

Illustration 9



IC Production: Supply of the Market with Domestic Products in 1982

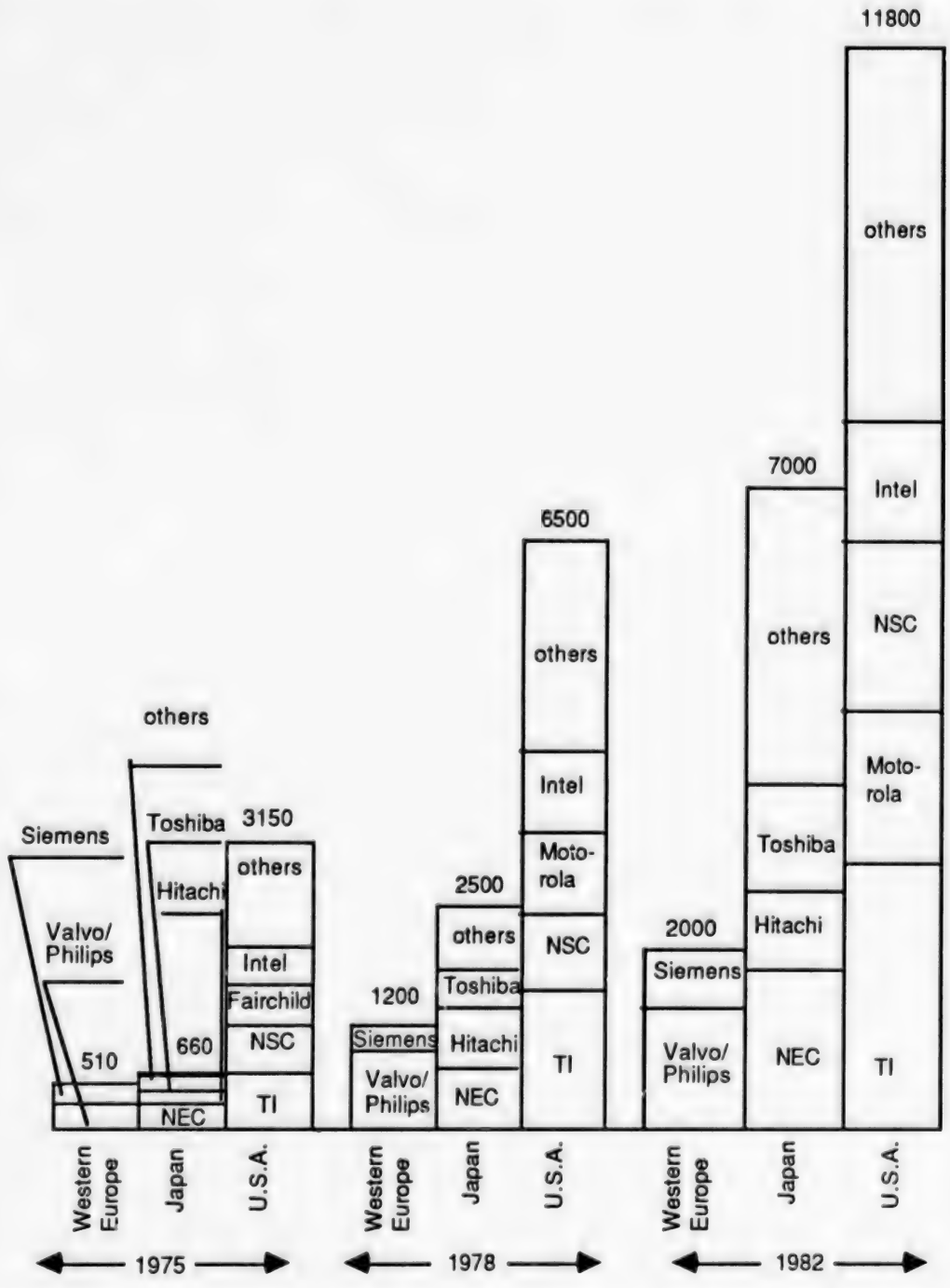
Source: Gnostic Forschung GmbH

microelectronics industry in the FRG--which has also been reached with the help of assistance programs from the Federal Ministry for Research and Technology-- must be viewed in positive terms. However, the technological strength of the German microelectronics industry cannot continue to be maintained without a clearly disproportionate growth in the market and in production.

A competitive industrial base in the area of microelectronics is, in the view of the Federal Government, of major importance and poses a challenge for all of Europe.

The increasing complexity of integrated circuits expands the scope of their functions to include subordinate systems. This also affects the division of labor in the manufacturing of components and accessories. Because of the key role played by integrated circuits in numerous industrial sectors, a close collaboration between users and manufacturers of microelectronics is of especially critical importance for the economic development of Europe and thereby of the FRG as well.

Illustration 10



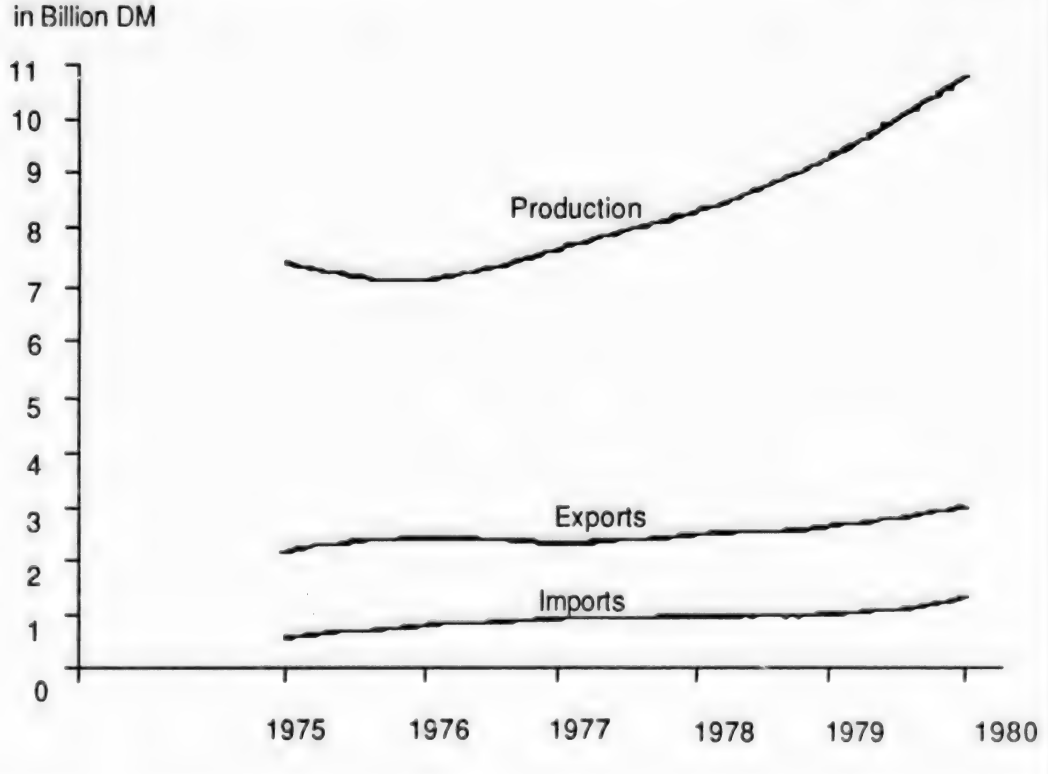
Distribution of the Sales Volume of the Twenty Largest IC Manufacturers (in Million Dollars)

Source: Valvo

III.2 Technological Communications

Communications technology with the subordinate fields of wire and radio communications as well as telecommunications cables continues to belong to the growth elements of the electrical industry, with production amounting to DM 10.8 billion and employing more than 110,000 people. An increase of 46 percent in five years in production (1975-1980) can be contrasted to a doubling in imports to DM 1.3 billion. For years, exports have been stagnating at a bare 30 percent (Ill. 11) and are clearly less than the export rate in the electrical industry (50 percent). The communications market is influenced by the state and is to a large extent controlled by the domestic monopoly of the *Deutsche Bundespost* [German Postal System].

Illustration 11



Production, Exports and Imports of the German Communication Technology
Source: ZVEI, IFO, Official Statistics

Unlike the case in microelectronics, electronic data processing and entertainment electronics, the domestic communications market continues to be determined by economically efficient German enterprises.

Telephone communications is still the major profit maker. By the middle of the 1980's, the telephone network will have been completed and universal service will have been achieved in the FRG. It is therefore imperative that the future markets based on the new communications technologies be accessed as rapidly as possible. This process involves the digitizing of transmission and retransmission technologies and the introduction of glass fiber technology, as

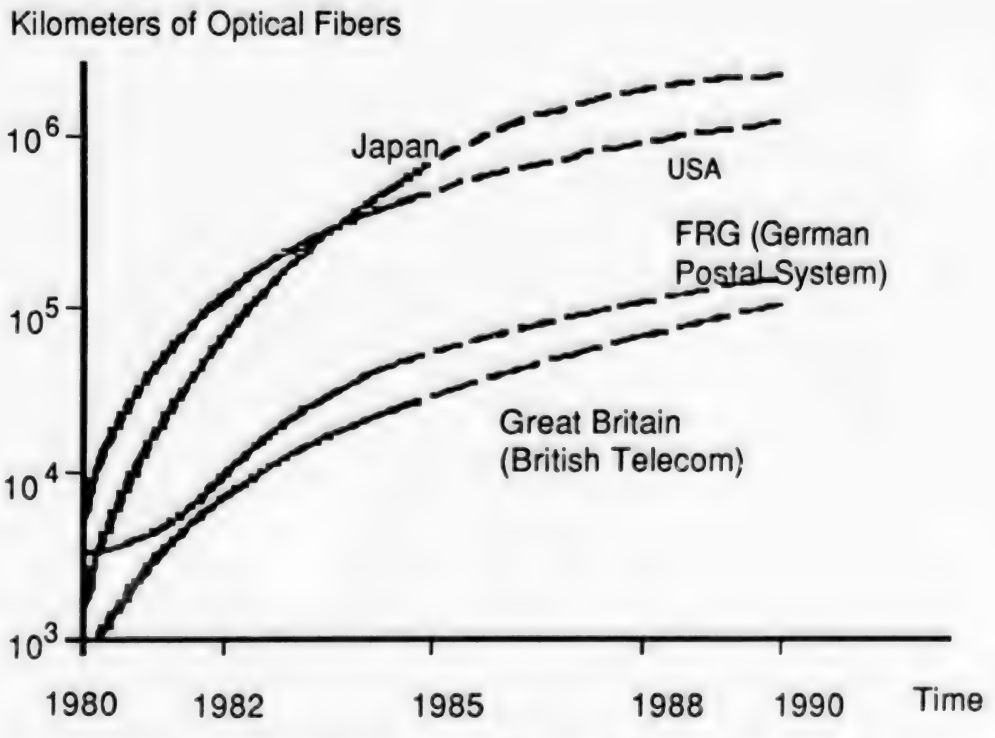
well as the utilization of point-to-point telecommunications satellites to transmit telecommuni - cations and data communications.

Especially high growth rates are predicted for new services which lead to low-cost devices and mass markets (e.g. videotext), in combination with various technologies (e.g. telephones and television sets).

High growth rates in the 1980's can also be anticipated for mobile automatic telephone systems and for many types of end-products in the area of technological communications, if correspon - ding introduction strategies are realized for the network infrastructure.

The most important factor in the expansion of the technological communications system in the FRG in the 1980's will be the implementation of digital technology for network infrastructures down to the customer.

Illustration 12



Present and Anticipated Demand for Optical Fiber Kilometers for Optical Fiber Systems (Culmulative Curve)

Source: telcom report 6 (1983) — Supplement "Data Communication Using Light"

The German telecommunications industry has in recent years been able to close the gap in digital transmission technology as compared with the French and Swedish firms which are industry leaders. Glass fiber technology in the FRG will lag behind the USA and Japan, if market expectations in the FRG cannot be revised upwards. Ill 12 shows the present and anticipated demand for fiber in km on an international comparison, in which the FRG lags behind the USA and Japan.

III.3 Entertainment Electronics

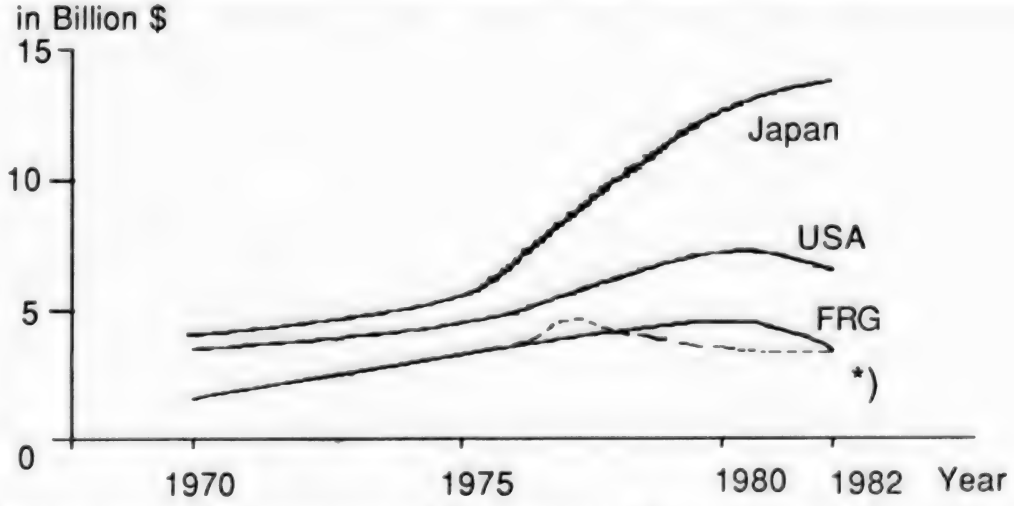
Markets in the area of entertainment electronics as well are increasingly affected by developments in the telecommunications infrastructure. Satellite technology, cable television networks, high-resolution television and also videotext and the general trend toward digitizing will greatly influence the entertainment electronics industry in the FRG and open up new opportunities.

The highest growth rates can at present be found in the video market. Since according to statistics published by the German Video Institute, at present only 13 percent of German households are equipped with VCR's, a figure which will increase to 25 percent in 1985, the video market represents an area of significant growth in the entertainment electronics market.

At present, however, the German entertainment electronics industry finds itself in a difficult situation: the television market is stagnating or expanding only slowly, pressure from imports is increasing, prices are falling, thus reducing the possibility of profits. The hi-fi market has been characterized for years by very intense competition, which has also characterized the video market recently. Falling prices are an expression of this intense competitive struggle. In the past three years, manufacturers' prices have fallen by c. 12 percent.

The development of production volume in the FRG as compared with Japan since 1970 (Ill. 13) shows that manufacturers in the FRG have fallen even further behind. In the European comparison, the German entertainment electronics industry was regarded for a long time as extraordinarily strong in terms of exports. Export surpluses have been declining since 1976, however, so that in 1981 for the first time an import surplus of approximately DM 500 million was registered. In the meantime, Japanese entertainment electronics products in the FRG have achieved a market share of c. 25 percent.

Illustration 13



An International Comparison of Production in Entertainment Electronics (in Billion $)

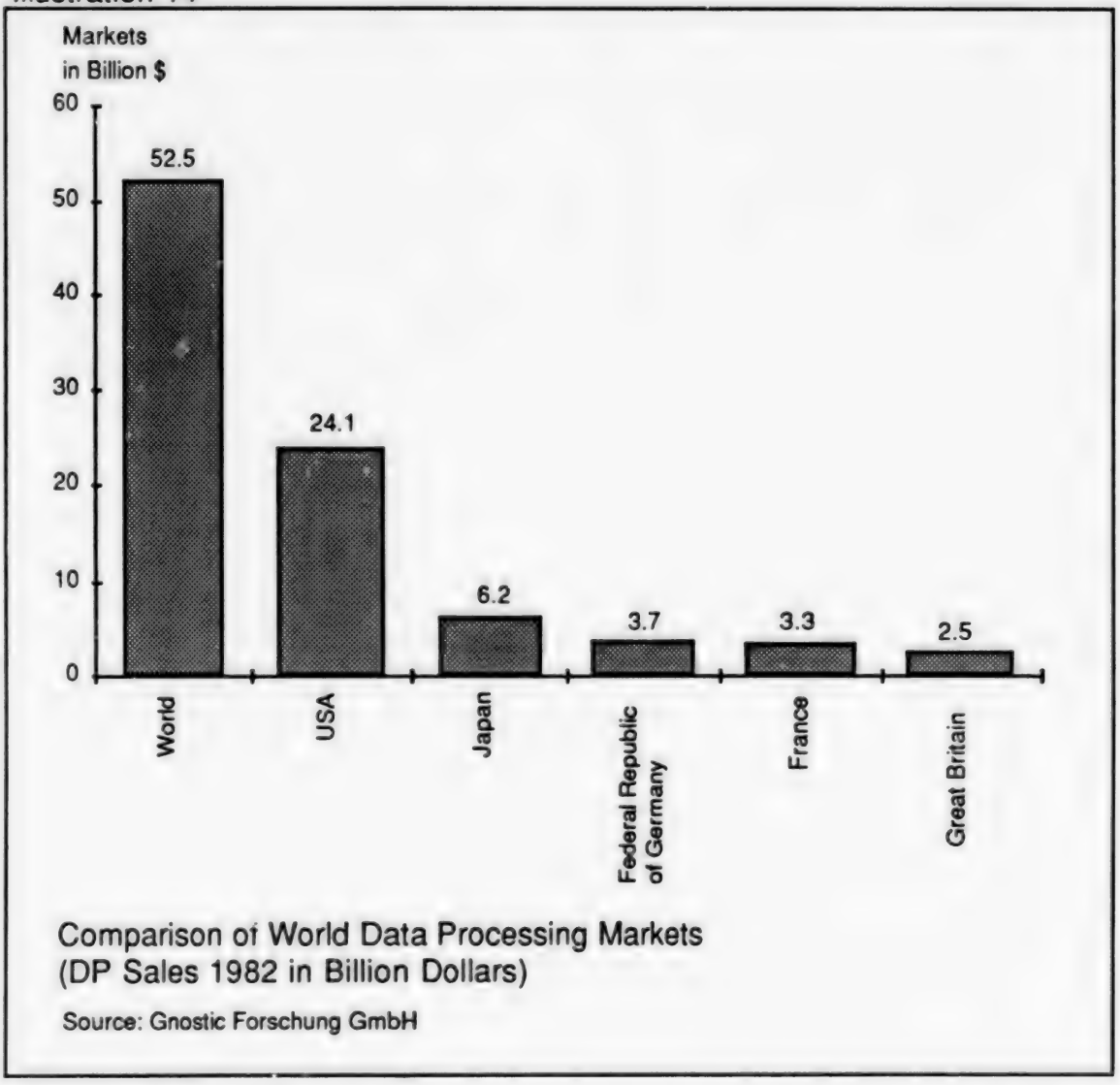
*) fixed base rate of exchange: $1 = DM 2.40

Source: Gnostic Forschung GmbH

III.4 Data Processing and Office Technology

The world market for data processing systems in 1981 had a volume of about $52 billion. The USA alone accounts for half of this market volume, with Europe accounting for barely one-third. Of this, roughly one- quarter is the market share of the FRG (Ill. 14). Thus the German share of the world market amounts to 6-8 percent.

Illustration 14

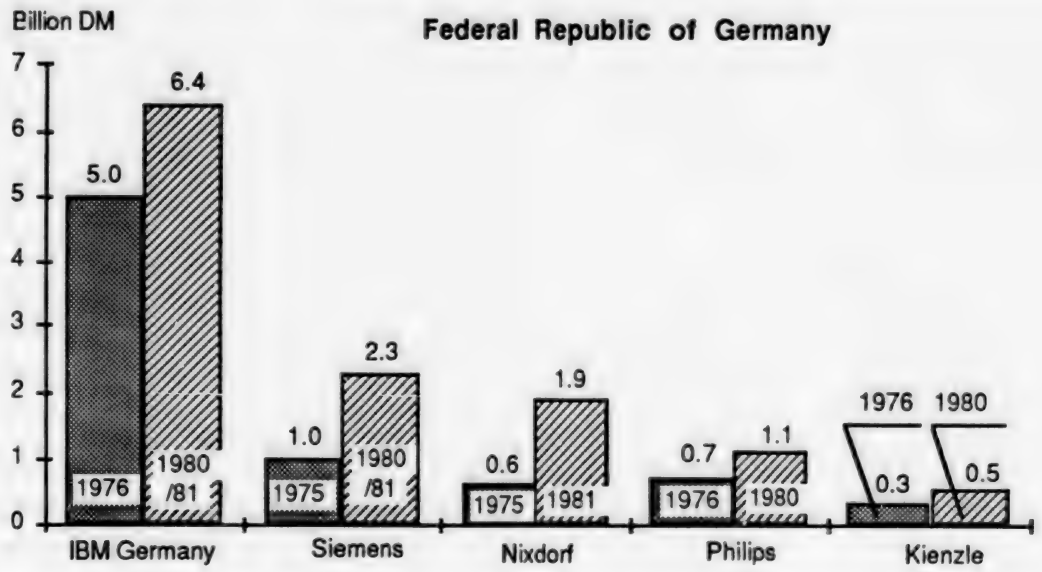


Comparison of World Data Processing Markets
(DP Sales 1982 in Billion Dollars)

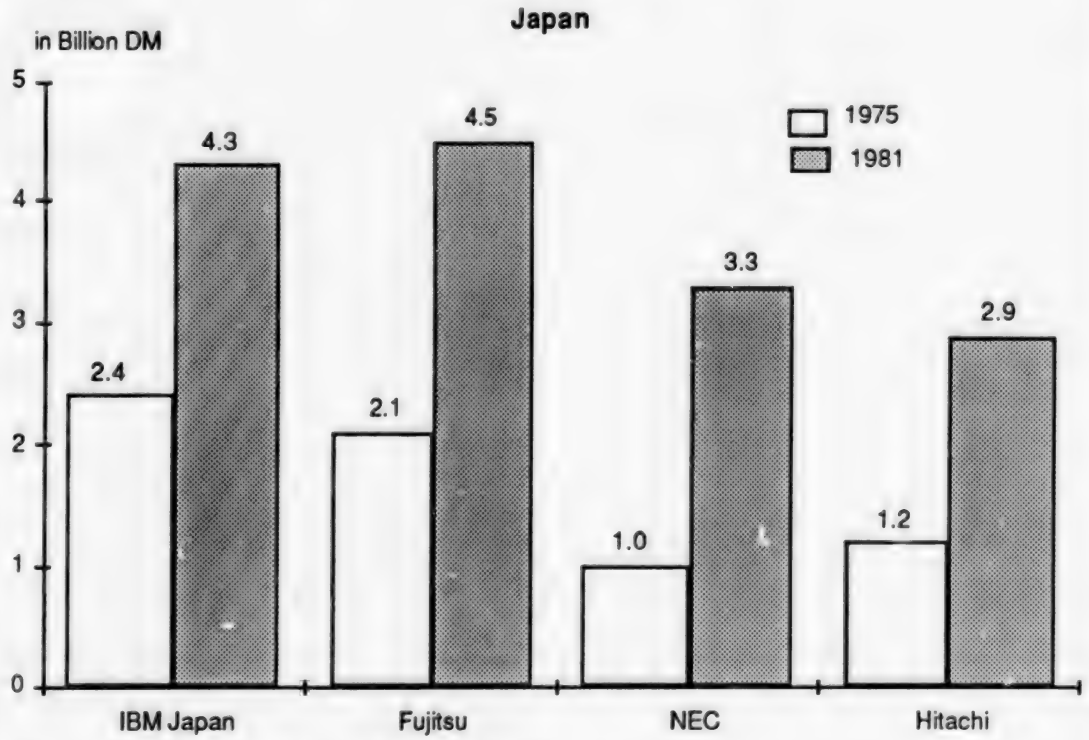
Source: Gnostic Forschung GmbH

Production and domestic sales have shown a considerable rise since the middle of the 1970's. The area of data processing has in recent years been one of the most reliable growth factors in the information technology industry. In Illustration 15, the sales volumes of the data processing manufacturers in the FRG and in Japan are compared and ranked in size in comparison with the market leader, IBM.

Illustration 15



Source: Parlamentary Circular 9/1556



Source: IDC/EDP Report-Japan Economic Journal
(Numbers rounded, 1 Yen ≈ DM 0.01)

Comparison of the Development of Sales1975-1981 for the Largest Manufacturers in the Data Processing Industry in the FRG and Japan.

Growth rates achieved by the two largest German manufacturers from 1975 to 1981 are noteworthy, being above average at 15 and 22 percent, respectively. The initial technological position is in European terms not unfavorable, either, (the German DP industry is the only one in Europe which can refer back to its own foundations in semiconductor technology and has at the present time in European terms the fastest domestically built computer.)

Nonetheless, an investigation of the effectiveness of previous sponsorship programs for data processing has reached the following conclusion:

> Even though German DP manufacturers were able to considerably expand their technological position and to achieve a significant growth in the market in the course of previous DP government sponsorship programs, the position of German manufacturers in international competition and in view of the continued changes in the product and systems segments has not yet been established for the long run.

Software represents an important part of the German DP industry. Software has been regarded as an independent production area only since 1970, after the sales of hardware and software were separated by means of the so-called "unbundling period." Since the 1970's, the area of software has been the most vigorously growing segment in the DP sector. At the present time, software represents 22 percent of the market of overall DP sales, a figure which according to relevant forecasts is expected to rise to 35 percent worldwide by 1986. This means an annual rate of growth of about 30 percent.

In 1982, software in the FRG had a market volume of DM 6.8 billion, with further growth estimated at 28 percent annually until 1987. Systems and software houses account for 43.5 percent of the market, hardware manufacturers account for 30 percent, and DP users for 20 percent (VDMA statistics).

Most of the over 1,000 systems and software houses in the FRG are small or very small businesses. Only about 2 dozen of these firms presently have annual sales of at least DM 10 million. But these companies also serve above all the domestic market and they are hardly active in exporting software, while many software companies, American but also French and British, with a solid capital base are actively engaged in exporting.

In the entire realm of office and information technologies, a structural change is taking place at the present time which can be described with the key words "decentralization" and "knowledge processing."

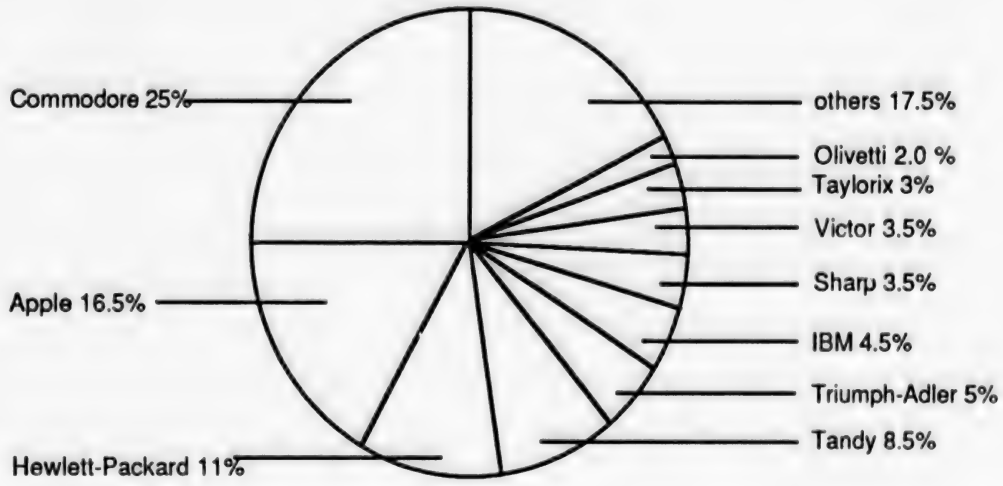
Decentralization is determined above all by the rapidly growing market for small computers (desktop computers). Although German industry has a strong position in both related market segments, i.e. in office typewriters and in small business systems, it has neglected the field of personal computers.

The personal computer market shows the greatest growth dynamic in the European DP market in terms of units sold, but it is worth noting that this market is dominated by US manufacturers (Ill. 16).

In the future-oriented developments in the field of knowledge-processing, which in the final analysis can lead to a fundamental improvement of the interface between users and data processing systems, German industry is still in an early stage. In this regard, the Japanese government with its program for a "fifth computer generation" is pursuing very high goals, which may be able to set new standards, but which will certainly lead to new computer

designs. German industry has accepted this challenge, but finds itself in a difficult position compared with a program that is largely funded by the state (as is the case in Japan).

Illustration 16



Market Positions of the Ten Most Important Professional* Microcomputers in the Federal Republic of Germany (end of 1983)

*above DM 4,500

Source: IDC

III.5 Industrial Automation

The main goals of industrial automation are increased flexibility and productivity in manufacturing processes. These requirements result from the market-imposed necessity of reacting in the case of small series faster and individually to customer specifications, without deviating too far from the typical costs involved in the production of larger series.

The most important factors affecting industrial automation are:

— data processing facilities;

— process control and computer-assisted design and manufacturing systems (CAD/CAM);

— NC machines;

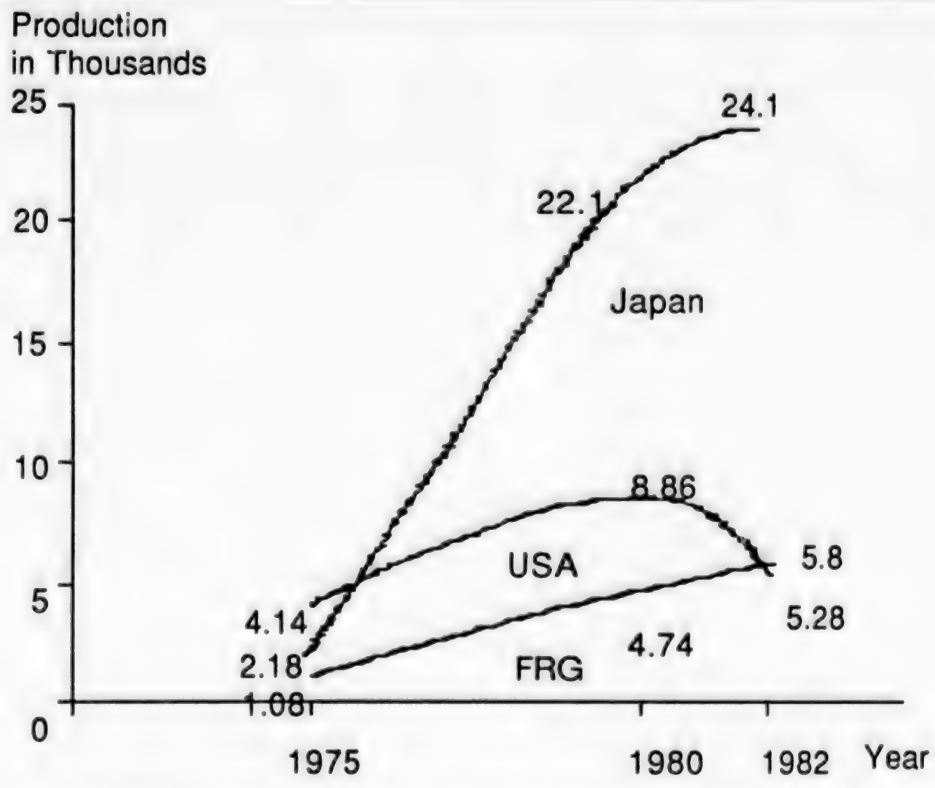
— flexible production systems;

— industrial robots and manipulation systems.

In the case of data processing facilities, the German manufacturing base is remarkable and its domestic market share ranks ahead of foreign competitors.

CAD/CAM helps to increase the efficiency of planning, construction and production processes. Corresponding devices and systems have been available on the market to any meaningful extent for just a few years, and up until now they have been implemented by relatively few businesses (e.g. large automobile manufacturers). In the manufacturing industry which consists primarily of medium-sized companies, i.e. mostly businesses in the machine construction sector, CAD/CAM has been implemented only by 2-3 percent of the companies. In Japan, 25 percent of machine manufacturers are said to utilize CAD systems. This is of the greatest importance because more and more industrial sectors must depend on CAD/CAM for their continued development. This can bring about new dependency on foreign suppliers. The availability of hardware and basic software for CAD is at present strongly to predominantly dependent upon American companies which have access to state-of-the-art technologies and a ready domestic market.

Illustration 17



International Comparison of the Production of NC Machines 1975 to 1982
(Remark: the development is less dramatic if dollar-values are taken as a basis rather than real production figures)
Source: Gnostic Forschung GmbH

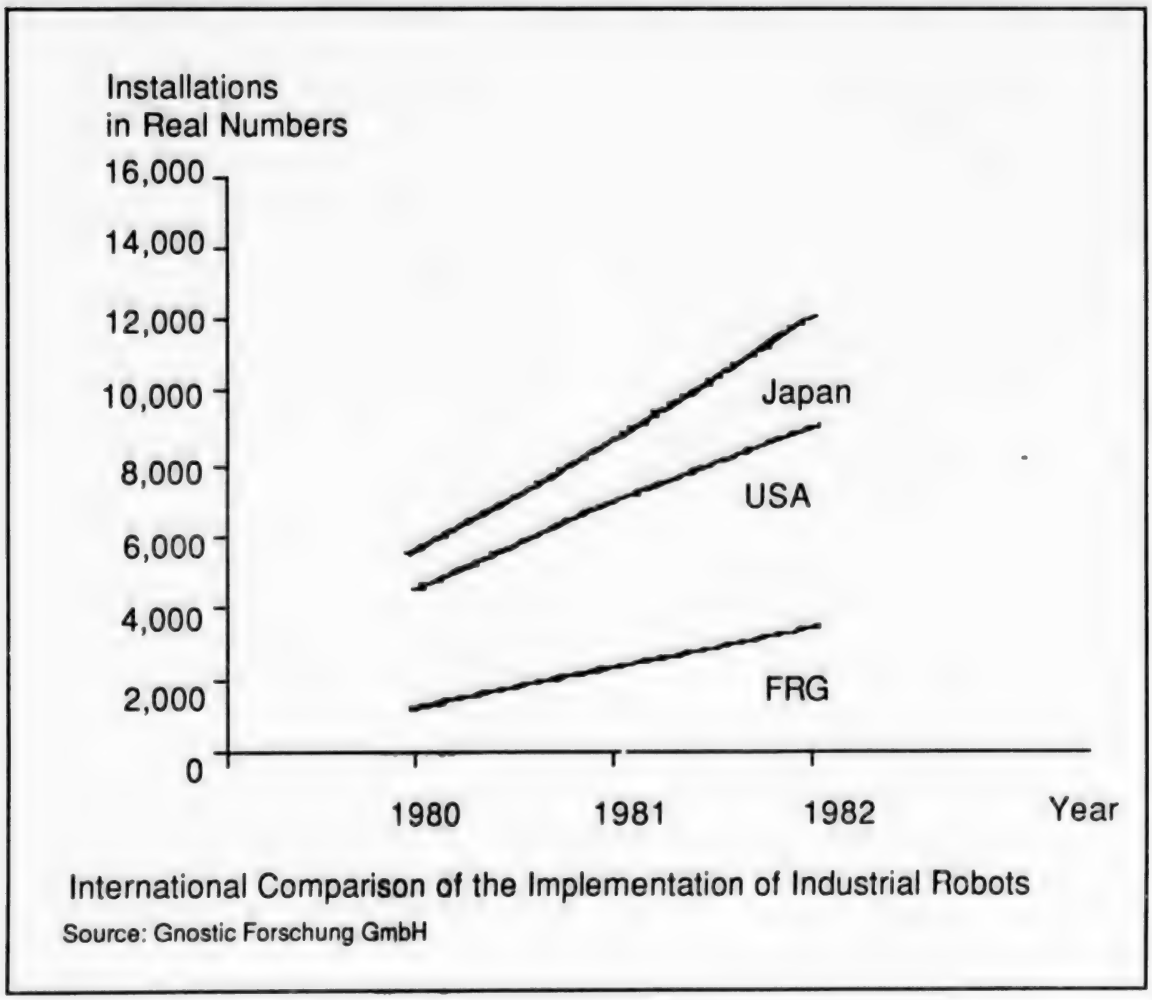
Since 1975, German production of numerically-controlled (NC) machine tools has increased by 600 percent. This meant that the FRG was able to keep pace with worldwide production trends (Ill. 17). The percentage of numerically-controlled aggregates in the total machine tool production output rose from 5.6 percent (pieces) in 1971 to 22.5 percent (pieces) in 1981. As much as 50 percent of domestic production is exported; the import percentage for numerically-controlled machine tools, however, also amounts to about 50 percent. While German firms enjoy a good position especially in the case of special machines and high-performance

machines, the Japanese dominate the market for normal and standard machines, since they are able to achieve considerable cost advantages as a result of large series due to rational production procedures. This also explains why Japan is able to produce 2.5 times as many NC machines per capita as the FRG.

The goal of the implementation of flexible manufacturing systems is above all to bring about a clear increase in productivity in small and mid-sized lot sizes. Although significant and rapidly growing prospects were predicted at the beginning of the 1970's for flexible manufacturing systems, actual developments have clearly lagged behind expectations. This is due above all to the fact that the problems involved in the development and operation of a flexible manufacturing system are considerably larger than had been originally anticipated. In 1981, about 15 facilities were operational in Germany, 20 in the United States and more than 35 in Japan. While for the systems in place in the FRG, highly complex installations predominate, which in international terms represent state-of-the-art development, most of the American and Japanese systems which have been realized up till now operate with less complex solutions which contain fewer different sub-systems.

The majority of the production machines that are manufactured in Germany correspond fully to the present state of international development.

Illustration 18



International Comparison of the Implementation of Industrial Robots

Source: Gnostic Forschung GmbH

In the area of industrial robots and manipulation systems as one of the important areas in modern manipulation technology, however, the industrial basis in Germany is still quite small. Of the robots installed in the FRG at the end of 1982, some 40 percent were imported. At present in the FRG there are only about 20 companies that manufacture a significant quantity of robots (production volume: c. DM 220 million). VW, the largest German robot manufacturer with a volume of about DM 100 million, has up to now produced solely to meet its own needs.

Illustration 18 shows that in Japan the number of industrial robot installations is at least three times as great as in the FRG. In Japan there are some 250 manufacturers with a production volume of c. DM 1.2 billion in 1981, with industrial robots in the narrowest sense accounting for some DM 840 million, which are manufactured by some 50 productive companies. In worldwide terms, the largest and the most productive robot manufacturers are based in the USA.

Although today robotics applications are essentially concentrated in the automotive industry, in the future assembly will play an increasingly important role, because the largest productivity reserves can be found in this area.

The use of intelligent robots opens up here the possibility of new solutions with an extraordinarily broad impact, which should not be overlooked by German industry as it seeks to maintain an internationally competitive position.

IV Objectives of the Federal Government

In its official statement of May 4, 1983, the Federal Government outlined its determination to accept the new technological challenges: "Our society needs technological progress." The Federal Government expressed its belief that in the rapid development of information and communication technologies, it sees new opportunities for growth and forward-looking job classifications.

The primary goal of the economic, financial and labor policies of the Federal Government is the combatting of unemployment. For this reason, the creation of new jobs is of top priority; this is only possible by means of an intensification of investment activities and a lasting economic growth. For this to come about, more room must be opened up for private initiative and independent economic activity must be encouraged, with a reduction in state interference in the economy. Above all, however, it is necessary to continue to improve the climate for private innovation and investment activity and to improve the investment strength of business. For innovative and therefore productive investments are in the final analysis decisive for the growth and competitive ability of our economy.

This means that the private sector must utilize all of the opportunities resulting from the application of new technological know-how and new technologies. Utilizing these chances also means, however, accepting and overcoming the challenges posed by related structural changes.

This is not possible solely within the national framework. It involves strengthening international cooperation between business organizations, particularly within the European Community, by the realization of suitable frameworks and by projects that focus on matters of common interest.

There are two factors involved in mastering information technology. On the one hand, there is the insight that information systems are advantageous to society. It cannot be denied that many information systems do not support this view in their present-day forms. In these cases, further research and development are required. An open dialogue with interested citizens should also help to reduce anxiety and to meet the technological challenge with understanding and the courage to play a role in shaping the future. A climate of public opinion that is hostile to the idea of innovation is not a basis for overcoming structural information deficiencies within our country.

On the other hand, knowledge is necessary in order to master information technology, since without such knowledge it is not possible to perceive the range of opportunities that exists. Since the spread of information technology, above all of programmable microcomputers as desktop computers or for process control, will include almost every sphere of activity, applications possibilities can only be fully utilized when very many people can handle these devices and can evaluate their functions. Education must play a role here.

The Federal Government regards the new information and communication technologies as key technologies which promise new growth opportunities for the economy. For this reason, science and business must keep pace with scientific and technological development and, wherever it is possible, move ahead into positions of leadership.

In the plan for supporting information technology, economic considerations are in the foreground. The Federal Government is also obliged to uphold the ideal of a "society with a

human countenance." The Federal Government is therefore concerned with the qualitative results of the implementation of new technologies, which are at present increasingly used in production as well as in the provision of services. In its research program "Humanizing the Sphere of Work" (*Bundestag* Publication 10/16) it has stated its position. The Federal Government also plans to publish a study entitled "Occupational Qualifications of Women in the Introduction of New Technologies," which is intended to counteract a worsening of occupational opportunities for women.

The availability of a wide range of information and of entertainment is growing continually greater, and with it also grows the necessity for the user to select from this abundance.

Here it is important to strengthen individual responsibility. The expansion and the utilization of new information technologies should help to improve communications between people, to expand the multiplicity of opinion in our society, to strengthen the freedom of information and of thought and to open up educational opportunities. The dialogue that the Federal Government intends to carry out with the states concerning the media regulations of the future will take these objectives into consideration.

The shaping and preservation of the free democratic state interconnects in many ways with modern information technology. Public administration, public safety and the administration of the law increasingly rely on modern information technology. The efficiency of state services can be enhanced by means of additional technical developments. Public administration must take care that the utilization of the new possibilities does not lead to rationalization at the expense of the citizenry. It is the objective of the efforts of public administration to achieve an appropriate interrelationship between performance, availability, user friendliness and expenditures in the implementation of information systems.

The Federal Government acknowledges its obligation to preserve the environment that has been entrusted to us for the benefit of future generations.

There is no technology less detrimental to the environment than information technology. Its implementation requires little investment in terms of materials and almost none in terms of energy. Information technology solutions contribute greatly to the conservation of energy used for heating, transportation and industrial production. Modern computer-assisted technological designs lead to significant savings in terms of materials, and the same is true of process control. Other important factors are the possibility of overseeing environmental stress by means of modern measuring techniques and data processing, both of which are part of information technology.

The consistent use of all of these possibilities can in many cases totally preclude any environmental damage which otherwise might be expected; at the very least it leads to a reduction in environmental stress. Environmental technologies open up new markets for the information technology industry.

The maintenance of the peace within the framework of the Atlantic alliance is also dependent upon military solutions for the foreseeable future. Information technology plays a decisive role in present-day defense. An advanced technological level on the part of domestic industry in this area is a prerequisite to ensure future defense readiness and the development of optimal defensive weapons and command systems.

Despite intense technological and economic pressure from competitors, the German information industry has an initial position that allows for expansion. In order for it to catch up, there is a need for an intensification and concentration of R&D resources and an improved framework for the transfer of new information technologies to commercial applications.

In its package of measures in support of information technology, the Federal Government places its confidence in the ability of German industry to produce innovations in the utilization of information technology, particularly in those areas where it already has a solid base, i.e. above all in the vast area of technological communications, in systems and products for industrial automation, in the construction of energy-saving and environmentally-sound modes of transportation and other innovative industrial branches with increasing requirements on a world scale, the products and production processes of which will continue to be influenced by information technology.

These measures are interdepartmental and concentrate on five focal areas:

1. improvement in the market conditions and thereby also in the competitive ability of the Federal Republic and Europe, with special emphasis on venture capital, the opening up of markets and on innovation-oriented public procurement policies;

2. motivating people to take up the technological challenge by means of information regarding future options as well as by paying more attention to information and communications in the area of education;

3. the stimulation of innovation-oriented markets by the future-oriented expansion of the communications infrastructure and innovations in the area of final products;

4. extending the technological base for the long-range securing of the defense capability of the FRG;

5. strengthening and concentrating the research capacity of the FRG in the area of information technology, with the objective of developing an R&D capacity in the public and private sectors which in certain focal areas would meet internationally competitive standards in terms of quantity and quality.

The Federal Government regards the challenges that must be met as a joint task confronting both the private and the public sectors. Confidence in the ability of science and industry to adapt and perform and societal cooperation are important factors in this process.

The Federal Government places its confidence on a willingness to achieve on the part of the people in a social market economy, a feeling of partnership among all participants and on the excellent point of departure enjoyed by the German economy in export markets.

V. Sponsorship Measures for Microelectronics and Information and Communication Technologies

In this section, the Federal Government presents the guidelines for its policies and measures as well as suggestions for activities of third parties. The Federal Government believes that none of the measures discussed here can by itself bring about a lasting success, but rather that a combination of measures must be utilized if current deficits are to be made up and a new dynamic is to be developed in the area of information technology in the Federal Republic. The Federal Government is resolved to do its part in bringing this about.

It regards the basic economic policy changes which have already been introduced and the changes in the general framework of conditions for the encouragement of the economy's own dynamic as important preconditions for success, but limits its observations in this connection to measures and tasks which are directly related to information technology in the wider sense (including microelectronics, data processing, communications technology and factory automation). The measures discussed in the following five sections derive from the previously described five focal areas:

In Section V.1, general measures and the conditional framework for the support of the information industry are described and explained.

In Section V.2, measures, incentives and tasks, aimed at the developing applications of information technology in the sphere of work, in education and in the private lives of citizens, are discussed from the viewpoint of the Federal Government.

In Section V.3, the area of technological communications, which includes the mass media, new forms of societal communication and communication between private individuals, is considered as one specific focal area.

Section V.4 is devoted to tasks and measures to secure the peace, to which in the view of the Federal Republic progress in the area of information technology can make a contribution.

In Section V.5, the decisions made by the Federal Government with regard to future research and technology policy in the area of information technology are summarized and explained to the extent that they have not already been included in the preceding sections.

V.1 Conditional Framework

Of all of the conditional frameworks, confidence in the future of the Federal Republic, in the ability of its science and industry and in societal cooperation is the most important factor.

In many countries rapidly effective measures are being sought to reduce unemployment, to improve the balance of trade and to strengthen domestic industry. Effective for the short term and therefore a great temptation is the restriction of free world trade in order to relieve and protect native industries. Especially in the area of information technology, the partial superiority of American and Japanese companies, coupled with covert or overt state assistance programs, enormous surplus capacities and corresponding price drops, poses an obvious temptation to resort to protectionist measures.

PLEASE NOTE: In the following discussions, the measures are indented and set off by appropriate headings. They are imbedded in the continuing text, and therefore the measure headings are not to be read as subdivisions of subchapters.

(1) Free World Trade

The Federal Government expressly supports the maintenance of free world trade including trade in the area of information goods and services.

The Federal Government is not only convinced of the willingness and the readiness of German industry to undergo a renewal process; free world trade is one of the cornerstones of its foreign policy.

*

Innovations in information technology, from microelectronics to data processing and office technology, entertainment electronics, telecommunications and industrial automation, are especially dependent on export markets. Germany's achievements in the area of information technology are rather underestimated in other countries. The most effective means of countering this impression is to resolutely orient German firms towards export markets. The Federal Government intends to use the means at its disposal to enhance the reputation of German information products and in this way to support the export efforts of German businesses in the area of information technology.

*

It is difficult to realize success in exporting without an innovation-oriented domestic market which can be used as a model and test market. In view of the large unified markets in the USA and Japan and the enormous expenditures for research and development which must be made by the leading hi-tech companies, the German inland market is not an adequate base, however. A homogeneous market within the European community is more important now than ever before. This task has been addressed by the Commission of the European Community.

(2) European Cooperation

The Federal Government supports the objective of the Commission to make the European market more transparent and more homogeneous for information goods and services. This also requires intensive work in the standards committees of Europe. It is necessary that the many types of trade hindrances caused by varying technical specifications be eliminated.

The Federal Government also expressly supports the development of a framework of conditions by means of which firms in the member countries would be encouraged to increase their cooperation with each other in a manner that is in keeping with regulations governing competition. EC subsidy measures should be used in a supplemental way to improve this conditional framework.

For this reason the Federal Government also regards the ESPRIT program as a valuable contribution to the stimulation of European collaboration and views it as an important support that complements the national measures.

In the view of the Federal Government, a liberalization of public procurement markets in Europe in the area of information hardware, systems and service could have an even more comprehensive and faster impact than the ESPRIT program. The Federal Government regards

as particularly important the areas of education and science, postal affairs, telecommunications and defense technology, which are discussed in greater detail in a different section, and also information systems in the area of transportation and traffic and in public administration. Like the EC Commission, the Federal Government believes that technological communications are an important factor in the future development of the Community in the area of information technology. The continued implementation of modern telecommunications technology in the EC by the various telecommunications administrations will help to improve the telecommunications infrastructure.

The Federal Government will move in the direction of reducing existing surmountable obstacles to innovation at home by adopting public procurement policies that favor innovative practices. A first step in this direction is the imminent amendment of the standard official contracting terms for services—with the exception of construction services—(VOL/A). In order to maintain competition in the procurement process there is, to be sure, no special preference spelled out for innovative procurement; however, the new guidelines have been designed on the whole to clearly favor innovation and they create a greater latitude for a corresponding solicitation and selection of bidders. For example, in the filing of new offers or amendment proposals, alternative and or new types of technological solutions can be included and considered during the contract awarding process. In the introductory comments on the amended VOL/A, reference is made to the innovative objectives of these aspects. A further change is the increased inclusion of small and mid-sized firms in the awarding of contracts.

To be sure, the innovation-oriented awarding of contracts places increased demands on the bidders in terms of system knowledge and competence. In this regard it is important to continue to improve the prerequisite conditions.

(3) Innovative Procurement Policies

The Federal Government will work in the direction of the full utilization of the opportunities for innovative procurement that are contained in the amended VOL. In this regard it will also seek opportunities to support government procurement offices by means of appropriate advisory services.

In its own procurement practices, the Federal Government will also give consideration to smaller, but technologically capable companies, even though such firms many not be able to demonstrate that they have been active for many years in the market.

It regards pilot procurement policies as a necessary step and will carry these out within the framework of the anti-monopoly regulations, if possible in consultation with the states and municipalities. A part of the required development will be supported by the Minister for Research and Technology after a case-to-case appraisal within the framework of his programs, without this resulting in a restriction of the spirit of competition.

West German industry has shown that it can achieve considerable success in technically advanced areas if undistorted conditions of competition exist, such as those that characterize the areas of chemicals, the automotive industry, electrical engineering, and machine and machine park construction.

The Federal Government will do its part to strengthen a spirit of innovative readiness and of competition in the information markets. The manufacturers of peripherals, who base their efforts on the usual market systems of other manufacturers, frequently see their development work and competitive chances made more difficult because of a lack of information concerning interface requirements for new hardware that is appearing on the market. If on the other hand

the possibility existed that computers and computer peripherals (e.g. CRT devices, desktop computers) of various manufacturers could be hooked together, the user would then be able to implement his own optimal solution by installing mixed equipment. In addition, the market for computer terminals and networking concepts could also remain open even when a decision concerning the central installation has already been made.

The Federal Government considers it desirable that standard interfaces be made public as quickly as possible in the interest of providing a broad spectrum of available products. The government would welcome steps undertaken in consultation with all concerned parties to standardize such interfaces to the greatest extent possible. In public procurement practices, care should be taken to see to it that information products possess standard-type interfaces.

(4) Disclosure of Interfaces and Communication Processes

> For this reason, the Federal Government will require in its procurement specifications that either official norms be used in products and interfaces, or that the bidder offer suitable interfaces and information concerning these for connecting or coupling their products with the products of other manufacturers. If such interfaces represent economic value, they are to be offered according to normal market conditions.

Finally, a decisive factor in the dynamic development of information technology is the willingness of the private sector to assume risk, to undergo a structural transformation and to seize the opportunity for new markets within the framework of an economy that is based on competition. Especially in information technology, because of the fast pace of technical progress a rapid transfer of developments to marketable products is necessary if existing markets are to be maintained and new markets are to be penetrated.

This is not a problem that confronts management alone; success also depends on the willingness of employees to accept change and to identify with the company that employs them. For this reason it is important that a spirit of partnership exist within a business organization and that people are aware that a good performance alone can guarantee the availability of jobs in the organization.

Part of this structural transformation includes the start-up and growth of new businesses. Such companies have contributed in a significant way in the USA to transforming the technological potential in the area of information technology into a broadly-based economic success.

The Federal Government has therefore decided in favor of an experimental model for the start-up of high-tech companies [TOU=*Technologieorientierte Unternehmensgruendungen*], by means of which the BMFT is to support the investment of private venture capital in new companies. Start-up projects in the area of information technology have special priority with the framework of this experimental model.

The Federal Government has also charged the Minister for Research and Technology to work together with the Economics and Finance Ministers to further develop the conditional framework for venture capital and for the acceptance of young companies on the stock market in such a way that the prerequisites can be significantly improved for independent young hi-tech firms to increase their own equity .

The ability of the FRG to remain competitive requires an optimal transfer of information, which includes fast and easy access to existing know-how and facts (specialized information). The Federal Government is concerned with improving the conditional framework for the specialized information market, particularly with regard to the elimination of existing inequities in the

availability of information. The Federal Government supports international cooperation in the area of specialized information, in order to counteract possible dependencies and infractions. The concept of the Federal Government concerning the improvement of technical information will be fully described in the Specialized Information Program 1985-1988.

V.2 Education and Information

The ability to deal with modern information and communications technologies is becoming more and more important in view of the increasing importance and spread of these technologies to many aspects of living and working. Our ability to preserve our currently high standard of living and once again to attain and to permanently guarantee full employment will depend to a great extent on the qualifications level of the future work force. Education, vocational training and advanced training must be understood in this context as an investment in our future.

The determination to continue to greatly reduce the number of occupations that involve hard manual labor or health hazards, the transition to electronic control processes in industrial manufacturing, the ability to come to terms with an environment that is characterized by a flood of information and also the desire of a society not to be dominated by computers, but to use computers as means to an end, requires an intensive confrontation with information technology in all segments of the educational process.

Since the application of information systems occurs in the various spheres of living and working, although according to the same basic principle (digital information representation, the transformation of real processes into programs that are executed by machines), a systematic introduction to these basic principles in the early school years is the most meaningful approach. At this level a broad spectrum of the population can be reached, independent of later courses of study.

According to the Basic Law, the states are authorized and responsible for educational affairs.

The Federal Government, however, must continue to urge that in the future, necessary new information and skills such as a basic knowledge concerning applications possibilities and the implementation of information processing systems is transmitted to all young citizens, insofar as this is possible.

At the beginning of the 1970's, the states began to introduce "information sciences" into the curriculum for Type II secondary schools, especially for the *Oberstufe* [upper level] in *Gymnasien*, and developed corresponding lesson plans. The Federal Minister for Education and Science offered financial assistance and followed this development closely within the framework of the joint educational planning (Article 91b Basic Law). Since 1971, the Federal Ministry has funded a total of 54 model projects with grants amounting to DM 260 million. This represents c. 50 percent of the total costs of these experimental models.

As far as the present situation with regard to instruction in the area of information sciences is concerned, a report by the standing conference of the state ministries for culture in the FRG (KMK) of May 6, 1983, entitled "On the development of information instruction in the FRG," points out that although information sciences are offered in all states in the upper level of the *Gymnasium* and in part in grades 9 and 10 in *Realschulen*, the content of these information courses still varies greatly from state to state. The report of the ministers for culture also ascertains that the urgently-needed further development of information instruction depends above all on the necessary prerequisites with regard to teacher-training and the availability of computers in the schools.

A rapid improvement in educational opportunities in information sciences can only be achieved by great efforts on the part of all of the states in the area of teacher training. Equipping the schools with computers is also important, but represents a less serious bottleneck in comparison with teacher-training and the development of curricular models. According to statistics contained in the KMK report, a certain minimal standard has been reached in the facilities available in upper- level academic high schools (*Gymnasien*), but the quality of equipment varies from state to state from 30-80 percent. The corresponding percentage for *Realschulen* is, however, still almost non-existent in most of the states. Only in Bavaria does it reach 40 percent, and only very few *Hauptschulen* have been equipped to date with computers.

State educational planning has up to now aimed only at offering courses in basic information sciences to schools that have an gymnasial upper level. In the future, all pupils attending Secondary I type schools must receive basic instruction to enable them to deal with information technology. This is especially necessary because today approximately 60 percent of an age group leave general public schools after the Secondary Level I, and thus the majority of young people would have no opportunity to be systematically introduced to new information technologies. This sort of a "basic universal qualification" would make it possible later on- -if necessary--to rapidly acquire specialized qualifications.

(5) General Schooling

The Federal Minister for Education and Science will strongly urge in the Federal-State Commission for Educational Planning and the Support of Research (BLK) that the federal and state governments within the framework of the BLK focal objective "Causes and Effects of Structural Problems in the Relationship of the Educational and Employment Systems" work out a plan for the rapid integration of educational programs for the introduction of information and communication technologies into general, vocational and extra-curricular education courses, with the goals of:

— developing and testing instructional models for the integration of information technologies into the curriculum for all students in Secondary Levels I & II;

— creating corresponding training programs for the teachers of all subjects and types of schools in Secondary Levels I & II;

— ensuring that all schools of Secondary Levels I & II are equipped with the minimum requirements in terms of hardware.

The Federal Minister for Research and Technology is prepared to help the state teacher-training institutions to eliminate the bottleneck in the necessary teacher training as quickly as possible with the help of the large-scale research institutions and research societies.

In this regard, the Federal Government welcomes:

— the information industry's announcement that it will donate computers to the schools;

— the offer from the Organization of German Computing Centers for their trained personnel to give assistance to the schools;

— the willingness of the Association of German Engineers (VDI) and of the Faculty Congress for Mathematicians and Natural Scientists (MNFT) also to cooperate in the area of teacher training;

— the offer of the *Gesellschaft fuer Informatik e.V* . (GI) and of the Faculty Congress for Information Sciences to take part in college and university teacher—training courses, to make training recommendations and to make pedagogical materials available.

A joint project "Computers and Education" of the Federal Ministry for Research and Technology (BMFT) and the Federal Ministry for Education and Science (BMBW) brings together representatives from technology, business, science, administration, politics and culture who wish to make concrete contributions to a rapid and widespread integration of information technologies into the educational system and to discuss ways in which this process can be coordinated. Another joint congress of specialists from the BMFT, the BMBW and the Hesse Ministry for Culture especially serves the working out and development of new course contents for instruction at Secondary Levels I & II.

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During the post-war period, the Federal Republic was able to build up a successful industrial base because it enjoyed a superb system of vocational education. Due to information technologies, the trend to inter-disciplinary requirements placed on learners will be intensified, for example with regard to abstract thinking, planning, communicative skills and group work. In the long-range view, whether or not a relatively high standard of living, judged according to world standards, and full employment can be attained and ensured will depend on the qualifications of the work force.

In recent years, the Federal Government has commissioned a series of studies concerning the question of what types of qualification changes are necessitated because of the widespread use of microelectronics, and it will call upon the participation of business organizations and trade unions to facilitate the subsequent implementation of the findings of these studies.

Necessary changes in qualification requirements are being incorporated into the unified federal education guidelines by the responsible ministers in union with the Federal Minister for Education and Science, with the participation of representatives of the social partners.

To the extent that preliminary work in the form of research projects and experimental models is required to determine more precisely the changes that must be made, such tasks are being carried out especially by the Federal Institute for Occupational Training. The number of experimental models in the area of "information technology and occupational training" is, however, still quite small.

(6) Information Technology and (Initial) Occupational Training

Because of the increasing importance of new information technologies, the Federal Minister for Education and Science announced in the Occupational Training Report for 1983 a new experimental program, "New Technologies in Occupational Training," which is being realized at the beginning of 1984 and which also deals with changing requirements in occupational training. Between DM 20-25 million are being used to finance some 2,025 projects in businesses, intercompany associations, educational institutions and elsewhere; furthermore, parallel experiments are being carried out in vocational schools within the framework of the grant program of the Federal-State Commission for Educational Planning and the Support of Research.

These various projects are expected to result in practical, transferable approaches to solutions which will support in a systematic and transparent way the introduction and dissemination of

information technology in the economy in the area of worker-qualifications. At the same time, these results help to further the steady development of occupational training, including the supervision or supplementing of existing educational guide

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The education of students in the subject of information sciences [*Informatik*] and in electrical engineering courses for engineers is of special importance for the dissemination of knowledge concerning the new information technologies and the development of practice-oriented applications for these technologies.

In recent years there has been a considerable increase in the numbers of students who apply to study information sciences, a desirable development in view of the rising demand. On the other hand, for this reason the course of studies for information sciences at scientific institutions had to be included in the nation-wide allocation process of the Central Office for University Placement (ZVS) after the Winter Semester 1982/1983. The continued strong demand has in the meantime led to discussions of whether it will be necessary to limit the number of those admitted to study information sciences at the colleges and universities. Such a measure would certainly run counter to the technology policy objectives of the Federal Government. We must see to it that the necessary educational capacity is made available without a loss in the quality of research and scholarship, also by means of temporary relief measures.

In addition to education in the above-named courses of study, the Federal Government considers it necessary that students from other technical areas, but also non-technical or non-scientific courses of studies, receive an opportunity to acquire basic computer literacy. Basic computer literacy, in part even the possession of a computer that is linked to a central university mainframe computer, has become a requirement at several American universities. There is in fact hardly a scientific discipline that does not require this basic aid. As a result of this continued development, especially with regard to the teaching of basic computer literacy, it will be necessary to equip institutions of higher learning to a greater extent with desktop computers.

(7) Higher Education

Within the framework of Measure (21), "German Research Network" (DFN), the Federal Government intends to test the possibility of equipping local networks with microcomputers for students. It is encouraging post-secondary institutions to establish computer funds with support from their respective state governments, by means of which suitable microcomputers could be purchased for use by the institutions and loaned out to students under favorable conditions and which could be provided with software from the institution's computer center.

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In order for those who have already begun their professional careers to master these technological changes, it is necessary to make available a broadly-differentiated range of opportunities for advanced training as well as retraining, with greater emphasis on information technology. The most important task will be advanced training and retraining by businesses themselves.

There are already corresponding opportunities for advanced training offered by a multitude of public and private training bodies. Plurality in these training bodies and flexibility in the range of advanced training opportunities are necessary prerequisites for an efficient advanced training system.

In order to improve an important aspect of advanced occupational training, in December 1983 the Federal Minister for Education and Science formally recognized the continuing education certificate for "Business Communications Specialist", *[Wirtschaftsinformatiker]* based on Paragraph 46 Section 2 of the Occupational Education Law, and established corresponding testing guidelines. Moreover, in numerous research projects the Federal Institute for Occupational Education is working towards the improved implementation of the new requirements in occupational practice.

(8) Continuing Education

In view of the special needs especially of mid-sized and smaller businesses to train their employees in the use of information technology, the FMES intends to test models for new types and communicative methods of continuing vocational education. These include the use of remote instruction in in-house training measures as well as the enhanced development of so-called "building-block" courses as independent but interrelated units in continuing education.

In this way especially the restrictions of time and place, which often represent an obstacle for small and mid-sized companies in carrying out continuing education, are to be eased and improved. In addition, the job-related or job-oriented courses that are available at the *Volkshochschulen* [university community outreach programs] (e.g. certificate courses) should be expanded; corresponding offerings by post-secondary institutions could be tried out within the framework of the experimental program in the post-secondary area of the BLK.

The media can also decisively help in part by the use of new technologies to reduce fear of the unknown by means of greater familiarity with the tool of the computer and in encouraging familiarity with this technology that is becoming increasingly important both in the home and at the work place. For this reason the Federal Government welcomes and supports the efforts aimed at developing broadly- effective introductory courses in the media. It will use all means at its disposal to participate actively in making computer hardware and software available, and will support the development of corresponding courses in the *Volkshochschulen* and in other institutions of continuing education.

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The opportunities, but also the problems, of information technology are the object of numerous investigations and public discussions. The Federal Government welcomes this debate concerning a technology that is helping to shape contemporary society. It would like to do its part to contribute to the objectivity of the discussion and to counter the pessimists with policies that are based on reality and oriented to the human factor.

(9) International Conference: "1984 and Beyond"

The Federal Government has commissioned the Federal Minister for Research and Technology to contract out far-reaching studies of information technology in keeping with a scientifically-based technology assessment: the results of these studies are to be compiled and offered for discussion at an international conference that is to be held at the end of 1984, entitled "1984 and Beyond."

Changes in working and living conditions that are due to technological developments are viewed positively and accepted by people when the benefits of such changes are evident. In view of a high rate of unemployment and the rationalization effects that result from information technology, it would be easy to believe that unemployment could be effectively combatted if the rapid implementation of information technology were dispensed with. At the same time, broad segments of the population understand in principle that foregoing these rationalization effects would lead both to an even greater direct danger for jobs in export-oriented sectors, as well as in the long run to damage and a decline in prosperity in the national economy as a whole. But filling the gaps between personal experience and an understanding of national economic processes requires that the workers and all citizens be adequately informed.

(10) Studies and Scientific Research on the Impact on the Employment Situation

> By the middle of 1984, the Federal Economics Minister together with the Federal Ministers for Labor and for Research and Technology will ascertain for which priority areas studies must be commissioned regarding the impact of new information and communications technologies on the employment picture, e.g. as special themes within the compilation of structural analyses, in order to learn how a stepped-up or slowed-down implementation of these technologies would effect mid and long-term growth and employment trends.

The rapid introduction of new information and communication technologies and the broad application of microelectronics can strengthen the international competitive position of the FRG and thereby help to secure or create job opportunities in this country. It can also help to once again strengthen endangered sectors in a gradual way, but it cannot solve in a conclusive way the fundamental problem of unemployment.

V.3 Technological Communications

The exchange and distribution of information with the help of electronic media are of paramount importance for modern industrial societies. Television, telephone, remote data processing, satellites and new data-gathering technologies influence the way in which people live together, are an important prerequisite for the ability of our industrial societies, which are based on the division of labor, to function effectively and themselves represent an industry with great economic dynamism and advanced technological requirements. Technological communications includes forms of business and private individual communication as well as forms of mass communication.

The great importance of technological communications in terms of the national economy, its innovative power and its importance for the functioning of democratic processes in the area of the electronic mass media point up the desirability of testing new forms and opening up new avenues of technological development.

These new forms of technological communication
require joint efforts by administration, science and industry, along with the application of significant funding and personnel support.

(11) Development Program

> As a basis for the development program for the extension of technological communication systems, the German Postal System [*Bundespost*] will work out a mid-range program

(c. 5 years) as well as a long-term perspective (c. 10 years) for the establishment of a digital telecommunications network and the introduction of optical communications. This will initially make it possible to use the internationally standardized narrow-band network ISDN (Integrated Services Digital Network) and a corresponding integrated broad-band network, Broad-Band ISDN, which are to be used for individual communications, especially in the business centers.

In order to enable cost-effective access to more radio and television programming and to make it possible to use broad-band selection services, the Federal Government, so long as economically feasible glass fiber technology is not yet available, will move rapidly ahead with the construction of coaxial cable distribution networks in keeping with demand and in accordance with economic considerations. It will also take into consideration the possibilities offered by directly-beamed radio satellites.

V.3.1 Individual Communications

The digitizing of the telephone network including user hook-up is the basis for the introduction of the ISDN. The Federal Government will endeavor to ensure that during this introduction, regional considerations receive adequate attention.

(12) Expansion of the ISDN

The *Deutsche Bundespost* (DBP) intends to test ISDN after 1985 and to introduce it after 1987, beginning in the business centers. ISDN should be available all over the country ten years at the latest after it is first introduced.

The DBP will provide the prerequisites necessary for a demand-oriented expansion of the ISDN, with, from the current perspective, a demand of 3-4 million ISDN hookups expected by 1995. The DBP and industry consider this goal as attainable and appropriate in marketing terms from today's point of view. Every two years, this objective will be readjusted to adapt to the demand that is currently anticipated.

Within the Federal Republic and in relations with foreign agencies, the DBP is responsible for the working out of standards which also within ISDN are to make possible communications between any users in speech, text, data and video.

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The strategic goal of the Federal Republic is the expansion of the current telecommunications network into a mediated broad-band network using optical communications. In order to reach this goal, the DBP will work out an overall design plan. In this process, the ISDN concept will be taken into consideration in such a way that the integrated broad-band network can be established on the basis of the ISDN.

(13) Broad-Band ISDN and Optical Communications

As early as possible, from today's perspective two years after the introduction of ISDN at the latest, work is to begin on the demand- and profit-oriented expansion of the long-range installation of the broad-band ISDN, so that by 1995 broad-band services can be made available for a significant portion of ISDN users.

Together with industry, the DBP will establish the prerequisites for the expansion of this broad-band network, which will meet the requirements of future users and which will be able to handle the demand that is expected.

In the long-distance network, the introduction of optical communications has already begun. This technology will link large cities and metropolitan areas throughout the entire FRG and West Berlin and in the next ten years (1985-1995) this expansion is to be stepped up (analogous to a highway network). Aside from accommodating a high volume of narrow-band services, this network will also link participants in the centers of demand for individual broad-band communication in accordance with demand.

In addition, satellite links will be established between points that are not yet connected via glass fiber cables for transmitted broad-band connections, as needed.

In order to test at an early date the manifold possibilities for the use of optical transmissions to the user, the DBP is carrying out 10 BIGFON experiments in 7 locations, the results of which are expected to be available in 1985-87. The DBP will also begin with the planning and expansion of optical transmissions between central exchanges in local networks a few selected areas with a need for individual broad-band communications (analogous to a city highway system). From these central exchanges, the link to users of individual broad-band communications as well as in the other direction the link to the long-distance network in keeping with the developments in costs and demand at the beginning of the 1990's can lead to the basic structure of a new broad-band communications network with optical communications technology ("overlay" network).

This objective will be adjusted every two years to expected changes in demand.

Furthermore, the *Deutsche Bundespost* will implement glass fiber technology in its long-distance networks in keeping with the technologically and economically available glass fiber technology, thus helping to bring about a smooth transition from the use of copper cable to glass cable in the transmission network. The DBP will work out a quantitative framework for this within the coming year.

The DBP assumes responsibility as well for a timely working out of the standards necessary for communication between any given users of the broad-band ISDN with the goal of establishing adequate specifications as soon as possible for the necessary equipment and systems developments.

In order to support the basis technology of the components of optical communication, the Federal Government intends to provide DM 260 million in funding from 1984-1988 in the budget of the BMFT.

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(14) Radio Telephone Service

In the foreseeable future, the DBP will offer a new radio telephone service which makes it possible to reach a mobile customer anywhere in the country automatically by means of a designated access number and for which the radio frequencies are automatically changed when the frequency boundaries are passed.

It is the goal of the DBP, along with other European telecommunications agencies, to establish a radio telephone system in the 900 MHz frequency area that would provide opportunities in the FRG for linking up approximately 1 million users and which would make it possible to offer a comprehensive radio telephone service in Europe. Current plans call for the introduction of this service after 1986/1987 and the completion of the first implementation phase by 1990.

In this regard, the BMFT is funding the development of a digital radio telephone system which allows for the integration of other radio services.

The DBP is assigning the RF interfaces for all public radio telephone networks, and above and beyond this within the framework of the CEPT is working towards an international coordination of these RF interfaces, so that comprehensive radio telephone service can be available beyond the borders of our own country.

V.3.2 Electronic Mass Media

By its lifting of the order halting the construction of cable networks which it had issued in 1979, the Federal Government has created the prerequisite for the development of a national technological infrastructure for television distribution networks. It is especially important that this infrastructure be put rapidly in place because of the serious gap that exists in comparison with several of our European neighbors, in view of the inauguration of the pilot projects with a multitude of tv channels as well as the regular Europe-wide transmission of tv programs via European telecommunications satellites, which is to begin in 1984. By means of the expansion of the signal distribution networks, at the same time the technical prerequisites for the improvement of the range of opinion in the media will be expanded.

According to its forecasted demand, the DBP assumes that in the next 5-7 years cable hook-ups will be available to about 50 percent of private households. The factors that will largely determine the demand for cable hook-ups for radio and television programming will be the costs involved and the number of programs that can be received. In order to encourage this programming, the DBP must erect in a timely fashion the technical facilities, e.g. directional radio connections, satellites and satellite earth stations. Additional programs, which are a very important factor in increasing the degree of acceptance of cable by private households, can be made available in 1984/1985 with the help of telecommunications satellites. Further developments will depend largely on collaboration from the states in the establishment of this important infrastructure as well as on their providing the necessary prerequisites in terms of media legislation.

Private initiative and private investments in the establishment of local broad-band distribution networks are of great importance in terms of economic policy. The DBP, together with other interested parties, has developed several different cooperative models for collaboration with private investors, which are being tested at the present time.

(15) Broad-Band Distribution Networks

In keeping with demand, the Federal Government will move quickly ahead with establishment of a broad-band distribution network according to economic principles. The Federal Government considers it not only desirable, but mandatory that an appropppriate infrastructure of telecommunications facilities for the distribution of television and radio programming via broad-band cable networks be made available to the population. The Federal Government regards it as sensible to develop such networks on a large scale, especially in those states and cities or communities in which a corresponding demand has been identified and where the necessary support from the states and communities can be counted on in the introduction of cable networks. Because of this procedure, it may happen that at first focal areas for cable access are formed in certain states, cities and communities. The Federal Government will attempt to prevent any one-sided temporal preferential treatment of cities and communities in densely populated areas in comparison to those in rural areas. Depending on the intensity of demand, financing possibilities, profitability and planning capacity, it is anticipated that between DM 1-2 billion will be available annually for the investment of the DBP in the establishment of broad-band distribution networks.

Since the developing demand for broad-band hookups will largely come from private households with the costs of cable hook-ups therefore being a decisive factor, the construction of the distribution networks will depend for the foreseeable future on coaxial cable technology. Even though these networks are technologically mature and therefore no significant technological development can be expected, their extension is nonetheless of positive value in terms of the national economy as a whole, if it takes place in keeping with demand factors and profitability considerations. At the same time it can be expected that software and hardware developments are accelerated under the implementation of microelectronics in the sector of entertainment electronics. In this regard, the beginning of broad-band cable hook-ups has already led to the introduction of new generations of hardware and has provided an impetus for continued development in the hardware sector.

When a mature technology is also available for distribution use in the glass fiber networks and at the same time a cost/profit relation has been reached that is comparable to that of copper and coaxial cable technology, which would correspond in the mid-range to the demand potential of this technology, such a technology will be used in this area.

(16) High-Resolution Television

The Federal Government supports the efforts to provide the necessary preconditions for a high-resolution television (HDTV) as quickly as possible. The DBP will ascertain in what ways suitable transmission modes can be made available for high-resolution television, also taking into consideration satellite technology. The Federal Government intends to provide DM 60 million for funding in the budget of the BMFT for technology development between 1984-1988.

V.3.3 Monopoly and Competition in Telecommunications

Through the timely planning of the expansion of the ISDN and the introduction of optical communications and because of the active efforts of the DBP in the prompt establishment of international communications standards, industry is receiving important impulses for the development of new types of user hardware. These will provide additional opportunities for

the information and the telecommunications industries to prepare the market for new consumer products.

(17) Hardware Market

In the case of user hardware, the DBP will continue its liberal policy regarding registration and will permit all those devices to be hooked up to these telecommunication networks which meet the registration requirements based on a review of their model type and for which qualified service is available.

The Federal Government will look into ways in which the most liberal conditions for supply and maintenance can be ensured in the future hardware markets.

The Federal Government anticipates an intensive competition with high rates of innovation and resulting growth in the area of hardware.

Furthermore, the question must be studied whether new structures can be found for the tasks of the DBP with regard to authorization and business practices, which would make it possible to react more quickly to technological, economic and political developments.

(18) Commission for Postal Affairs and Telecommunications

For this reason, the Federal Government will set up a highly placed commission with representatives from business, science and politics, which by the end of 1985 is expected to issue a report on these questions, in which developments in other countries will also be taken into consideration.

V.4 Defense Technology and Maintaining Peace

The ability to maintain the peace within the framework of the Western defensive alliance also requires a defense technology with an industrial base in the FRG, which corresponds to the specific interests of the Federal Republic. In view of the geopolitical situation in Europe, the strengthening of the conventional defensive capability of NATO in Europe is a task of paramount importance.

Microelectronics and information technology play an important role in this regard, both for a weapons technology that is best suited to the defense of the FRG and also for the related intelligence and command systems, both of which heavily rely on communications, and their integration throughout the alliance.

In defense planning, development and procurement, the Federal Government basically depends on a division of labor and responsibility in the interests of closer coordination and cooperation within the Western defense alliance, because the national economic costs of defense can be limited and its efficiency guaranteed only if cooperation exists among the partners in the alliance.

The Federal Government regards it as necessary, however, that this cooperation be based on reciprocity in research, development and in the procurement of defense materials, and it believes that Germany should have a defense industry which is capable of developing and manufacturing defensive systems and the technologies on which they are based, which are oriented towards the interests of the FRG and which utilize state-of-the-art technology. It is

important that our industry has this capacity so that it may be recognized as an effective partner in jointly-developed projects. The close collaboration with suitable partners, especially with France in the area of R&D in the framework of intensified cooperation in the area of security policy, is of special significance.

(19) Defense Research, Development and Procurement

In the developments in the area of electronics, the Federal Government sees an opportunity to decisively strengthen the capabilities of the *Bundeswehr* in fulfilling it's defense mandate.

In consideration of the report of the Commission for Long-term Planning for the *Bundeswehr*, the Federal Government charges the Federal Minister of Defense with following developments in the areas of:

— microelectronics;

— communications technology and

— information processing,

to utilize these developments from the point of view of the Bundeswehr's needs in meeting its mandate, by means of targeted, applications-oriented research and development, and to undertake its own adequate efforts in the area of defense R&D to make the future more secure.

Within the framework of the research and technology concept which is to be worked out by the Defense Minister, appropriate measures have been planned in cooperation with institutes and industry.

For the area of defense research in the area of information technology, moreover, a close coordination must be effected with other ministries, such as the BMFT and the BMP, in order to optimize the use of resources and findings for defense technology. The Federal Minister of Defense will therefore participate in the formulation of special programs and the related individual tasks of the other government departments, in order to influence planning in an inter-departmental way in consideration of his ministry's mid- to long-range requirements.

In order to ensure the protection of data both in the transmission of personal data as well as for defense purposes, it is necessary to study new techniques for encrypting information transmissions and to further develop these techniques in relation to the new communications services. For this reason, the Federal Government will initiate an inter-departmental R&D program for encrytping techniques, which is to be headed by the Minister of Defense.

V.5 Research and Technology

The measures described below are oriented to the principles of research and technology policy as formulated by the Federal Government in its Annual Economic Report for 1984 in Tz. 16 and in its answer of November 23, 1983, to the Major Interpellation regarding a "New direction for the research and technology policy of the FRG." According to this, among other things the scope of the subsidy measures is to be reduced in so far as this is possible.

In terms of government support for information technology, two aspects are especially in the foreground. On the one hand, broad, indirect measures must receive more attention than they have in the past, in order to avoid restricting competition. On the other hand, it is important to increase the efficiency of limited R&D resources in our country by combining related R&D activities, by means of stepped-up cooperation and improved technology transfer.

The technology subsidies described in Chapter V.2.2 are concentrated in three areas which are internationally regarded by technology experts as key areas:

— electronic components (Chapter V.5.2.1)

— electronic data processing (Chapter V.5.2.2)

— industrial automation (Chapter V.5.2.3)

Within these focal areas, the subsidy measures held to be necessary in a few important key technological areas are described and explained. In this process, indirect-specific types of support can be considered when for macro-economic considerations R&D in important technological fields require a broadly effective short-range support. The indirect-specific type of subsidy allows the individual company to seek its own solutions to its R&D problems.

In the case of support for joint research, the focus is on a division of labor to handle long-term research and development tasks that involve high risks, are very costly and which would overtax the resources of the private sector, with the joint research being divided among various business enterprises and research institutes. Participation in joint research should be available in principle to all interested parties.

Existing R&D capacities are therefore more efficiently utilized and the previously large number of small, individual projects is thereby reduced. By bringing together interested users, manufacturers, R&D facilities and universities, joint research has a less selective impact.

The establishment of subsidy quotas is oriented primarily at the financial risks entailed in the projects. In the case of joint research, the subsidized companies share 50 percent of the costs involved. Because the indirect-specific type of support often results in marketable products, in this case the subsidy is reduced to 40 percent and is strictly limited in its duration.

The figures given for the financial requirements of the various measures are subject to continuation in current financial planning, and it is possible that available funding might be shifted between the various measures.

V.5.1 Research

The growth of research capacities in the area of information technology has lagged behind in the FRG when viewed in an international comparison.

On the one hand, in the USA the state via its expenditures for defense research finances an enormous research capacity in the area of information technology, in industrial laboratories, government research institutes and at the universities. Moreover, there are several large companies in the area of information technology which can afford from their own profits to support large research laboratories. Especially prominent are the Bell Laboratories, which were formerly financed by the telephone fees of AT&T, and the research laboratories of IBM.

In Japan, especially the Ministry for Foreign Trade and Industry and the public telecommunications corporation finance very important research capacities in the area of information technology. Moreover, there exist in Japan several large, high-profit companies in the area of information technology, which devote large amounts of their resources to long-range research.

Among European countries, France has begun to play a leading role in greatly strengthening its research capacities in the area of information technology.

Although as a whole significant resources are used in the FRG both for industrial and non-industrial research, we have not yet completely succeeded in orienting the priorities of the large-scale research institutes and the joint federal/state research institutes more strongly to the dynamics involved in information technology. Additionally, many universities, after the expiration of subsidies for information sciences within the framework of data processing programs, have serious difficulties in terms of equipment and the necessary increase in personnel in the area of information technology, which cannot be underwritten by the DFG. And finally, the profits realized by German industry from its information products, given the limited domestic market, frequently do not suffice to allow them to close the gap out of their own resources. Inidividual initiatives by the states to compensate for this shortfall by establishing or expanding their own state institutes are in principle very much to be welcomed; however such efforts entail the risk that limited personnel resources will be linked to inadequate capital resources.

Without effective research in the area of information technology, however, the competitive position of our economy could be endangered in the long run.

Given this situation, the Federal Government has identified three primary tasks:

— strengthening applied research in the forefront of industrial activities, but in close coordination and cooperation with industry;

— strengthening research carried out at colleges and universities, large—scale research institutes and other research institutes which are jointly funded by the federal and state governments;

— better utilization of existing resources by division of labor, cooperation and communication within the Federal Republic and within the framework of the European Community.

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Applied research prior to industrial development is at the present time being carried out at larger institutes, above all within the framework of the Society for Mathematics and Data Processing of the Fraunhofer Society and of the Heinrich Hertz Institute GmbH. Individual activities are also being carried out at several large-scale research centers and at the universities. There is an almost complete lack of research laboratories which bring together for a certain period of time researchers from industry, public research institutes and universities to work on a given task, and who, after completion of the task, by returning to their various organizations provide for an effective transfer of their research findings.

(20) Research Infrastructure

For this reason, the Federal Government would welcome and support efforts by industry and the above-named research institutes to find an effective way to coordinate public and

private sector research and to organize joint research groups to deal with specific tasks within a given period of time.

Such an agreement would have to allow for the later inclusion of other partners and in general must not conflict with the legal ramifications of competition.

This type of cooperation would also result in various types of opportunities for dialogue between research and industry and between individual business enterprises. Therefore it is also a platform for further cooperation in the forefront of competition.

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If only because of the large number of universities, research in the Federal Republic in the area of information technology will be located in many different areas. For this reason, cooperation means communication, the exchange of findings and reciprocal use of instruments across large distances. As the example of the ARPA network in the USA shows, the networking of the computers of research groups makes it possible to bridge great distances and to integrate various locations.

(21) German Research Network (DFN)

The BMFT has begun to assist the development of a "German Research Network" (DFN). The network relies on the public infrastructure (the network of the *Deutsche Bundespost*); however, interfaces must be agreed on and regulations (so-called protocols) developed, in order to enable an exchange of information, data, computer software etc. between computers of various manufacturers. Research groups at the universities, at research institutes or in the private sector and technical information facilities can participate in the network. The Federal Government intends to allocate DM 100 million of its budget from 1984-1988 for the development of the DFN.

In order to maintain a solid basis in the area of information technology in the 1990's as well, in addition to this, broad basic research in many different directions is required. In the view of the Federal Government, existing basic research capacities in the area of information technology are inadequate. The German Research Organization (DFG) devotes at the present time approximately DM 35 million annually for this purpose. This is approximately 4 percent of the subsidies it receives.

(22) Basic Research

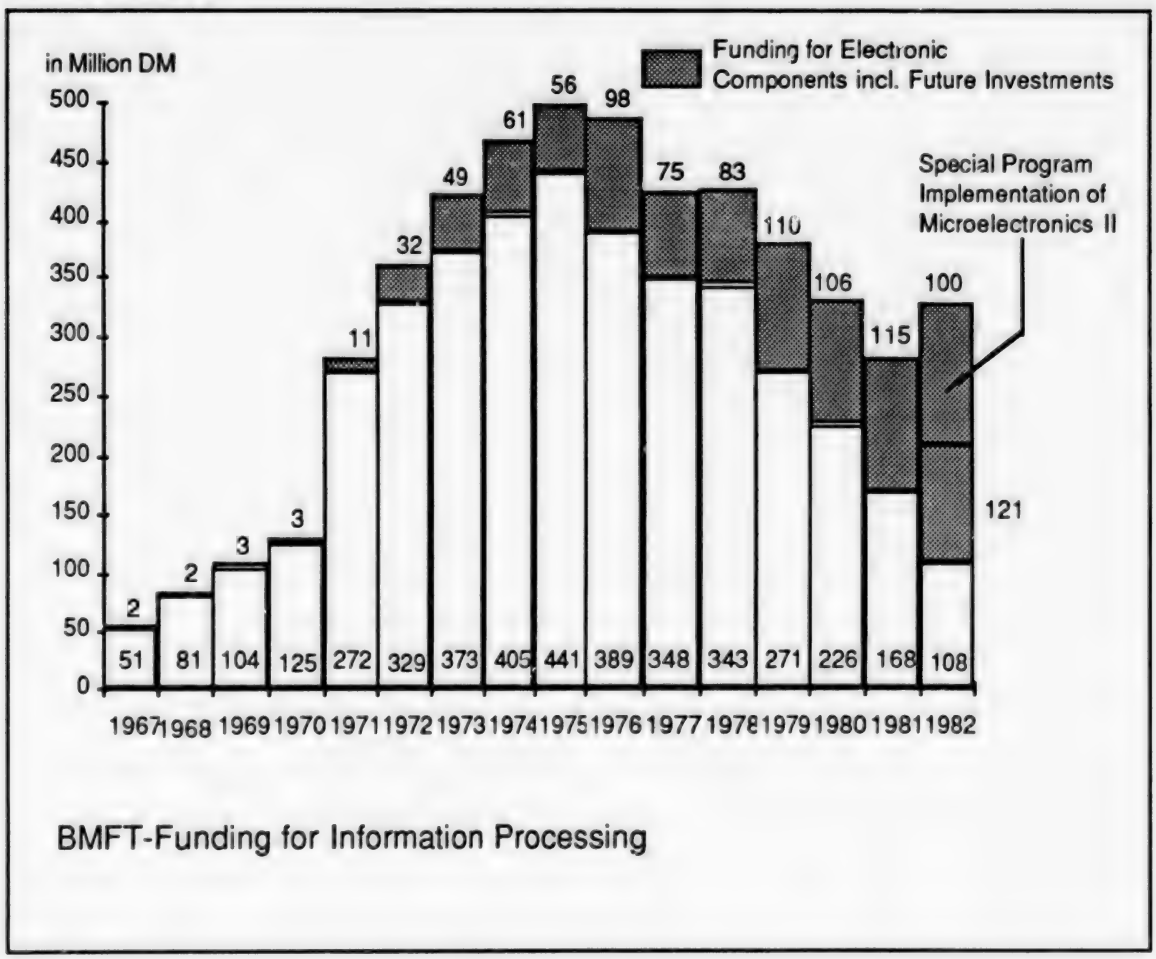
The Federal Government intends to make available up to a total of DM 100 million for targeted purposes over 5 years to the German Research Organization in order to strengthen basic research in the area of information technology, on the condition that the DFG also expands its efforts in this area. It is also encouraging the Max Planck Society to intensify its research in the area of information technology. Moreover, it has charged the Federal Minister for Research and Technology with studying the question of the advisability of a new research center being established at the Nuclear Research Facility (KFA) in Juelich, where basis technologies for information technology could be researched in a complementary way to the tasks of the GMD, based especially on the competence of the KFA in the area of solid state physics.

V.5.2 Technology

The Federal Government initiated its support for information technology in 1967 with the first data processing program.

By 1979, a multitude of projects concentrating on the technology, architecture and applications of data processing systems had been sponsored, with annual expenditures that finally amounted to approximately DM 350 million (Ill. 19). An evaluation of the DP subsidies, which was concluded in 1982 by two consulting firms, indicated that the underestimating of the requirements for a market penetration and a less than optimal use of support measures were the main reasons why the program enjoyed only limited success and a permanently secure position for the German DP industry had not yet been achieved.

Illustration 19



BMFT-Funding for Information Processing

After the drastic reduction in DP subsidies and their restricted use to basic research, the measures in the area of information technology concentrated above all on securing the technological basis in microelectronics and in optical communications and on supporting several basic research projects concerning knowledge processing, pattern recognition and software technology with a modest application of funding.

In microelectronics, the technological basis could be essentially maintained. All in all, the German manufacturers emerged in a better economic position from the past component crisis than did most of their foreign competitors. However, the sales figures are comparatively

speaking too small to guarantee German companies a secure, long-term market position. A broad applications basis for microelectronics in the FRG is therefore important, not only from the point of view of innovation, but also for reasons of batch quantities with a view to domestic component manufacturers. Attention is paid to both of these points in the special program for microelectronics applications, which is to terminate by 1984, and which is having an effect especially in the area of investment goods.

In recent years in the area of technological communications, a number of applications areas have been opened up due to government assistance programs, in which new technologies are transferred to systems such as teletex, videotext, BIGFON, highway emergency radio and digital mobile radio. In the future this type of systems subsidy is to be expanded by means of even more effective instruments, above all the investment concept of the DBP. Technology subsidies will be concentrated even more intensively on optical communications, which had already been pursued as a main focal point. The most important task is the development of optical communications as a technological basis for telecommunications in the 1990's, in order to establish the prerequisites for a future-oriented investment planning by the DBP. A considerable amount of basic research is still necessary for this.

In data processing, the German manufacturers are undertaking greater efforts in order to utilize the ways in which data processing and communications technology (*Telematik*) are coming together and the market opportunities resulting from this. In this process, entertainment electronics may be expected to give off increasing impulses for the consumer product market. German industry must come to terms above all with three deficient areas:

— the limited market in the FRG in comparison with the USA and Japan;

— the small base for applied research outside of industry;

— the lack of new enterprises which could utilize growth opportunities by means of innovative products, supported by an existing technological basis and an established venture capital market.

In view of the limited R&D resources in our country, it is extremely important that a greater degree of efficiency in these efforts be achieved by means of more intensive collaboration. For this reason, the Federal Government has concentrated the assistance programs that are subsequently described in three main focal areas and has arranged that the research activities are to be jointly carried out by several industrial partners and public research institutions, with the objectives of the projects being jointly determined and updated in strategy discussions in which research, industry and the government participate.

V.5.2.1 Electronic Components

The gap in the manufacturing of microelectronics, which was described in the first chapter, can only be closed when the gap in microelectronics applications is also eliminated. The special program for microelectronic applications 1982- 1984 with a volume of DM 450 million has brought about a positive development in this regard. Although it is still too early for a final evaluation of the perspectives of microelectronics applications in the FRG, it can already be seen that a breakthrough has been achieved, especially in the area of investment goods. Here also the multiplier effect upon microelectronic applications in terms of the national economy are especially great. To be sure, there is a serious bottleneck precisely in the area of investment goods, i.e. the lack of appropriate microelectronic-compatible sensors and activators. This area is especially interesting for mid-sized businesses in cooperation with research institutes and universities.

(23) Special Program for Microperipherals

> The Federal Government charges the Federal Minister for Research and Technology to establish a program for microperipherals. With the goal of the rapid availability of cost-effective, intelligent microelectronic-compatible peripheral components (especially sensors and activators), corresponding development projects--such as in the program for manufacturing technology--are to be supported by means of an indirect-specific measure. In addition, the know-how basis for future-oriented concepts for such components is to be developed in an internationally competitive way, in joint projects between research institutes and the private sector. The Federal Government intends to make available DM 320 million in funding for this program from 1985-1988.

The application of microelectronics in the FRG also greatly depends on cooperation between users and component manufacturers in developing systems solutions with small batch sizes, as is typical of the investment goods industry, which are internationally competitive.

(24) Computer-Aided Design (CAD) for Integrated Circuits

> For this reason the Minister for Research and Technology supports developmental tasks and consultation in the area of computer-assisted design of integrated circuits in industry, universities, the Fraunhofer Society, the VDI Technology Center, the Society for Mathematics and Data Processing and the Heinrich Hertz Institute. The Federal Government intends to make available budgetary funding amounting to DM 90 million for this main focal area during the period 1984-1988.

The FRG will, however, only be in a position to count on a similar degree of penetration for microelectronic applications as in Japan and the USA when the existing potential users of microelectronics actively and promptly occupy this market. In order for this to happen, it is necessary that the corresponding key microelectronic components are available in time. These key components must be based on new technologies. Systems technology plays a decisive role in this. New systems technology concepts, e.g. pipe-line structures, arrays and self-testing functions, must be studied and tested in terms of their possible applications and the effects on throughput, openness to diagnostics routines und space requirements on the component. This requires preliminary research and development, which entails considerable technical and financial risks.

(25) Key Components

> In order to speed up the broad implementation of microelectronics, the Minister for Research and Technology is charged with supporting the technological and systems development for selected key microelectronic components within the framework of his programs, in the presence of extreme technological and economic risks. For this purpose the Federal Government plans to make available budgetary funds amounting to DM 90 million for the period 1984-1988.

The Federal Government assumes that the measures described in the area of microelectronics applications will contribute to closing gaps in the area of applications. It also assumes that the manufacturers of microelectronics will recognize and actively utilize the market opportunities in the FRG by means of appropriate R&D activities and investments.

The increasingly close collaboration between users and manufacturers of microelectronics due to the systems character of integrated circuits requires productive manufacturers here at home. Despite above-average growth rates for domestic manufacturers in the German market and a partially excellent technological position, the industrial base is still too small to be able to finance from its profits the necessary comprehensive industrial research efforts in the area of microelectronics. In order to prevent our research from falling behind in the area of microelectronics and in order to ensure that we will be taken seriously as a partner, it is necessary that a merging of efforts and a division of labor be organized for long-term research with the inclusion of state-funded research institutes. A basis for this merging and division of labor has come about in recent years. This basis and the willingness to cooperate must be utilized, and the Federal Government will do its part to bring this about.

In order to secure the research base of microelectronic technology in the long-run, the Federal Government will support the development of foundations for new electronic components in three main focal areas:

(26) Submicron Project

The Federal Government charges the Minister for Research and Technology with a joint project for the develop of submicron technology, with the objective of making available by the second half of the 1980's a competitive submicron technology and a mass production process that is based on it. Research facilities of the Fraunhofer Society and industry as well as the universities are closely collaborating in this program. The Federal Government intends to make available funding amounting to DM 600 million for this program between 1984-1988.

(27) New Component Technologies

The Federal Government charges the Minister for Research and Technology with overseeing a new focal area for sponsorship, "New Component Technologies," directed at new concepts for components, which are not based on the customary silicon base (e.g. new semiconductor materials, opening up of molecular-type technology). It intends to make available approximately DM 200 million in funding from 1984-1988 for R&D projects--preferably to be carried out in cooperation with several research organizations.

(28) Integrated Optics

The Federal Government charges the Minister for Research and Technology with increasing support for R&D in the area of integrated optics. As a first step, a focal area for integrated optics is being established at the Heinrich Hertz Institute in Berlin, which in close cooperation with other institutes and with industry is to work out foundations for the optical chip. The Federal Government intends to make available DM 90 million in funding for the focal area of integrated optics from 1984-1988.

V.5.2.2 Electronic Data Processing

As a result of the interconnectedness of data processing, word processing and communications technology and the reductions in cost and increases in performance levels that are made possible by microelectronic developments, new market opportunities exist all over the world

for the data processing industry, with the private sector being responsible for identifying and utilizing these opportunities.

In the view of the Federal Government, it is necessary in three area to contribute by means of support for R&D to the long-term providing for future needs.

The first area includes design technologies for computer hardware and software. Without aids for design and simulation, complex computers and larger software systems can no longer be developed. If such design aids can be made accessible to a wider circle, this would result in considerable multiplier effects. Government sponsorship that is linked to this condition leads to an accelerating effect for new systems and is a possible decisive factor in the enduring competitive position of the German data processing industry.

(28) Computer-Aided Design (CAD) for Computers and Software

> The Federal Government charges the Minister for Research and Technology with establishing a focal area of sponsorship for "Computer-Assisted Design for Computers and Software," which is intended to lead to modern design aids for the second half of the 1980's, by means of future-oriented joint projects. It intends to make available DM 160 million in funding for this purpose from 1984-1988.

This funding is intended to help improve the competitive ability of German firms by means of cooperation and sponsorship. The considerable costs involved in systems for the design of larger computer systems underscores the need for European cooperation within the framework of the ESPRIT program--this all the more so since several of the interested partners are located in other parts of Europe.

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The second area encompasses computer structures. The efficiency of traditional computer structures is being more and more restricted by in-built limitations. Further advances in the capabilities of computers can be achieved either by costly technological progress in the area of components or by the parallel processing of information. The latter case requires other types of computer structures, i.e. the interaction of several processors. For certain types of tasks, such computers offer optimal solutions, since they are far superior in terms of performance to conventionally constructed computers. The research focusing on new problem-oriented computer architectures has already made significant progress. Research groups in the FRG enjoy a good reputation worldwide in this regard, although the industrial application of new types of computer architectures is extraordinarily difficult, because of the limited national market and the tough competitive situation, which makes it necessary to concentrate resources. A new focal area for government assistance, which is closely linked to procurement plans in the areas of science and government, should help to establish a link between industrial research and potential applications in the development of new computer structures.

(30) New Computer Hardware Designs

> The Federal Government charges the Minister for Research and Technology with the establishment of a focal point for government assistance, "New Computer Hardware Designs," which is to assist in the development of the research and application of new computer structures in close connection with the need for specialized computers in the scientific area and for applications in speech and image recognition as well as in

knowledge-processing. It intends to make available DM 160 million in funding for 1984-1988.

The third area includes knowledge processing and pattern recognition. In the long run, experts believe that three related problem areas will emerge in the area of data processing: the processing of knowledge in expert systems, speech recognition aimed at simplifying the interface between man and machine, and image processing, which is aimed above all at quality control in the manufacturing of parts. With these technologies, the computer becomes a simple-to-operate thinking tool. This is in a nutshell also the objective of the much-discussed Japanese project for the fifth computer generation. The multitude of problems ranging from speech and image recognition to the direct representation and processing of knowledge must be approached in view of the limited resources in the FRG by means of a division of work among research institutes and industry, with the goal of implementing partial results in industrial applications. The results achieved in the previously-mentioned focal area of "New Computer Structures" will make valuable contributions in the form of the necessary hardware technologies for the solution of these tasks.

(31) Knowledge Processing and Pattern Recognition

> The Federal Government charges the Minister for Research and Technology with establishing, in addition to the existing focal areas of speech recognition and image processing, a further focal point for knowledge processing, in which support would be given for future-oriented solutions in pattern recognition and knowledge processing within the framework of joint projects. It intends to make available DM 200 million in funding during the years 1984-1988.

It is appropriate programs (software) that enable computer hardware to carry out designated functions and to realize desired applications. For this reason, software is a very essential component in data processing systems, the total costs of which are determined to a large and increasing extent by the cost of software. Software has increasingly become a bottleneck factor in the further distribution of data processing systems, especially because a rational production technology for software comparable to that of mechanical manufacturing has not yet been implemented to the extent that this would be desirable.

(32) Software

> The Federal Government intends to give appropriate consideration to software companies in the supplementary program for personnel costs, the continuation of which was announced by the Federal Government in its Annual Economic Report for 1984. The software companies will be included in the decision whether the hiring of new personnel for the expansion of existing R&D capacities should additionally be supported as a supplement to the existing program .

V.5.2.3 Industrial Automation

West Germany industry is in a leading position worldwide in the area of industrial automation. Deficiencies in the application of microelectronics are expected to be largely eliminated by impulses resulting from the special program for microelectronic applications. Research institutes in the FRG cooperate closely with industry and enjoy an excellent reputation. Nonetheless, three deficiencies are evident at the present time in this area, which is of such

decisive importance for the export strength of German industry. For this reason, the program for Manufacturing Technology that was passed by the Federal Government and for which a total of DM 530 million in funding has been appropriated for 1984-19887 is intended to focus on the following three points.

On the one hand, the opportunities resulting from computer-assisted design and computer-assisted manufacturing (CAD/CAM) especially in mid-sized businesses of the investment goods industry still remain inadequately utilized. But especially these technologies are of increasing importance for the competitive ability of the manufacturing industry. If barriers to the initial use of CAD/CAM systems can temporarily be lowered, the result would be an effective long-term increase in the competitive position of this industry.

For this reason, the program provides for financial assistance in the introduction of CAD/CAM systems.

The second deficient area concerns the manufacture of robots. Although West German industry uses robots for a large number of purposes, the industrial base for modern manipulation technology is small in comparison. This gives rise to a growing danger that the positive employment impact of the manufacture of robots in a particularly dynamic market will be utilized primarily by foreign countries, while the FRG claims for itself the advantages of rationalization with the related loss in jobs.

For this reason, the development of robots will be supported by the program.

The third deficiency is based on the fact that complex systems developments in industrial automation today require expenditures on a scale that in many cases can no longer be managed by individual mid-sized companies. The state-supported industry in the USA, Japan, France and Great Britain, supported also by larger corporate units, is able to outfit long-term projects in this regard with considerable resources.

The program therefore provides for the support of joint projects in which industry and research will work together in close cooperation.

VI Further Developments

The Federal Government is aware that the measures described in this comprehensive plan cannot be of a conclusive nature in view of the dynamic development tempo of information technology. For this reason it will keep a close watch on further developments in this area and initiate additional measures if such a step should be indicated.

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